

**END OF YEAR 2001 THROUGH YEAR 2006
CLOSURE / CLOSEOUT PLAN**

CHINO MINES

Prepared For: Chino Mines Company
Hurley, New Mexico

VOLUME I

**EXECUTIVE SUMMARY AND
REGULATORY / ENVIRONMENTAL COMPLIANCE PROGRAM**

March 2001

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M3 Engineering & Technology Corp.

**To be resubmitted to the State of New Mexico
within 5 years to update compliance
requirements**



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Certification

This Closure/Closeout Plan (CCP) has been prepared under the supervision of a Professional Engineer registered in the State of New Mexico.

M3 attests that its unit costing and material takeoffs have been carried out independent of the Permittee and in accordance with M3's interpretation of MMD and NMED regulations.

M3 has reviewed the various key technical documents prepared by the various subconsultants. In general, the development meets or exceeds that typically associated with feasibility level work.



Conrad E. Huss
Initial Registration January 23, 1981

Preface

M3 Engineering & Technology Corporation (M3) has estimated capital, operating and maintenance costs for the Proposed Reclamation Plan and a Comparison Case. As an engineering construction manager, M3 prepares between 100 to 200 such estimates each year. Under separate cover, M3 intends to provide a bid for the CCP Proposed Plan reclamation construction at costs indicated in this report.

In the compilation of this document, M3 has been cognizant of written commentary by MMD and NMED. These letters are listed in Appendix D, "Bibliography", Item 1. The technical positions presented herein are based on studies by various subconsultant specialists competent in environmental issues as they pertain to the State of New Mexico.

Sections 1 through 9 have been authored by M3. Sections 10 and 11 have been authored by the permittee and are included with this CCP for completeness.

These studies address the primary and secondary issues discussed during the evolution of these comprehensive scopes of work. Tertiary issues such as specific engineering details can be evaluated meaningfully upon the development of final construction documents at the time of closure.

In order to present a more easily readable and clearly defined document, past queries by MMD and NMED have been answered by the substance of the various chapters. To avoid disjointed text, specific responses to past mis-statements or incorrect assumptions of the various parties have not been recounted. As a result of MMD and NMED queries, the following reports are being issued for the first time:

DBS&A. *Stockpile Outslope Evaluation Mass Loading Modeling Results for the Chino Mine.* March 2, 2001 (Appendix G)

Golder Associates, Inc. *Summary of Long-Term Stability Analysis for Stockpiles and Tailing Ponds at the Tyrone Mine.* March 16, 2001 (Appendix F)

M3 Engineering & Technology Corporation. *RUSLE Erosion Calculations for Rhyolite and Gila Conglomerate Cover.* March 2001 (Appendix E)

SRK Consulting. *Conceptual Water Treatment Design Closure/Closeout Design, Closure/Closeout Plan, Chino Mines Company.* March 2001 (Appendix G)

M3 suggests that future individual correspondences on the part of all parties be limited to single rather than multiple areas of discussion. Verbal inquiries for clarification might best precede written inquiries to keep extraneous and misinformation out of the record.

Final written correspondence should specifically and succinctly summarize queries in the form of itemized exceptions and concurrences as opposed to running commentary. Likewise, revisions would be facilitated if technical and commercial questions listed the technical and commercial reasons or calculations for asking.

M3 recognizes the importance of this plan and has striven to keep the documents herein consistent.

With the continuing cooperation of NMED, MMD and Phelps Dodge, M3 can assist in refining this plan satisfactorily to the citizenry of the State of New Mexico.

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1. Plan Summary

1.1 Purpose of Plan

The purpose of the comprehensive Closure/Closeout Plan (CCP) is to present the reclamation and closure plan for the Chino Mine and to calculate the associated financial assurance for bonding purposes in the event that Chino is unable to implement the described plan. The plan was developed to comply with the criteria of State of New Mexico laws and regulations, specifically the New Mexico Mining Act and associated rules and the New Mexico Water Quality and New Mexico Water Quality Control Commission (WQCC) regulations. The CCP is designed for approval as a permit revision for Chino's Mining Act Permit No. GR009RE and as a new closure discharge plan to satisfy closure requirements under the WQCC regulations.

This CCP is based on anticipated mine development at the end of Year 2006. If cessation of mining activities occurs before this time, the disturbance will be less and the financial assurance calculated herein will be conservative; i.e., the performance bond monies will be in an amount greater than is needed to complete reclamation as described in this plan. Hurley smelter disturbances are excluded from this plan.

Development of closure/closeout plans for Chino, Cobre Mining Company (Cobre) and Phelps Dodge Tyrone, Inc. (PDTI) has involved over 20 environmental consultants. Over 10 of these have made specific contributions to the Chino plan. Some 200 technical investigations and references support this comprehensive effort. This report represents a summary of these considerable efforts.

1.2 Organization of this Report

The purpose of this Section is to:

- a) Describe the overall organization of the report, and
- b) Highlight the key investigations, findings and plans

Section 1 describes how the report is developed. Studies of key alternatives with technical and commercial aspects are briefly discussed. This information is discussed in greater detail in later sections.

Section 2 describes the current environmental setting of the Chino Mine including geology, fauna, flora, history, existing facilities, current disturbances and discharge permits.

Section 3 describes the physical facilities that must be taken into consideration for the CCP in the context of state regulations. These issues are discussed with specific reference to permitted areas described in Section 2.

Section 4 describes the proposed post mining uses for the Chino permit area facilities described in Section 3; i.e., how the area will function after closure.

Section 5 describes the general scientific design basis, specific construction technology, and post-closure monitoring concepts to achieve and verify the objectives of Section 4.

Section 6 applies the technology of Section 5 to specific permitted areas listed in Sections 2 and 3. Evaluation matrices are developed for pits, stockpiles and tailing ponds.

Section 7 presents the Capital Cost Estimates for the project descriptions contained in Section 6.

Section 8 presents the associated operating and maintenance costs for the project descriptions contained in Section 6.

Section 9 presents the calculations that support the overall value of the bond necessary to appropriately fund third-party costs for capital expenditures, operating and maintenance.

Section 10 discusses areas of the facility proposed for waivers pursuant to Mining Act Rule 506.C.

Section 11 outlines an end-of-mine-life closure/closeout scenario for the currently anticipated remaining life of the mine after 2006.

1.3 Design Scenarios

This report presents and compares two design scenarios for reclamation of the Chino permit area. As discussed in Section 1.1, State regulations require a reclamation plan and cost estimate be prepared to support the development of financial assurance. The purpose of presenting and evaluating two scenarios is to contrast the proposed closure and reclamation plan that is designed to meet all applicable regulatory requirements with an agency-requested comparison case.

The specific details of these two reclamation approaches are described in Section 1.5. (Figures 1-1 and 1-2 show the proposed plan perspectives of the projected reclamation.)

The scenarios were evaluated from a comprehensive perspective considering the combined environmental, operational, and economic effects of each case. In addition to being comprehensive, the evaluation is also forward-looking having considered the long-term implications of the proposals

The amount of area that will be disturbed in association with reclamation is one aspect of environmental protection that was evaluated. The amount and types of disturbance for the two reclamation scenarios are tabulated below. The SSE established designation refers to areas that will be revegetated to meet the full requirements of section 507.A of the NMMA. The Stabilized Area designation

refers to lands that may or may not be vegetated to meet the requirements of a self-sustaining ecosystem, but will be reclaimed using measures that are protective of air and water resources and public health and safety. In some aspects, the comparison case would result in increased environmental performance, such as the degree of revegetation or aesthetic attributes.

Analyses of environmental problems related to water quality indicates that the comparison case shows negligible difference with the proposed plan.

The proposed plan during construction requires fewer resources. The following tabulation summarizes acreage considerations.

<u>Area of Disturbance (acres)</u>		
	<u>Proposed Plan</u>	<u>Comparison Case</u>
Tailing Ponds	3867	3867
Stockpiles	2307	2558
Open Pit	1894	1894
Buildings, Utilities & Misc.	580	580
Cover Borrow Areas	610	1115
	9258	10014
<u>Proposed Plan Area of Reclamation (acres)</u>		
	<u>SSE Area</u>	<u>Stabilized Area</u>
Tailing Ponds	3867	0
Stockpiles	831	1476
Open Pit	0	1894
Buildings	580	0
Cover Borrow Areas	610	0
	5888	3370
<u>Comparison Case Area of Reclamation (acres)</u>		
	<u>SSE Area</u>	<u>Stabilized Area</u>
Tailing Ponds	3867	0
Stockpiles	2558	70
Open Pit	0	1894
Buildings	580	0
Cover Borrow Areas	1115	0
	8120	1964

As indicated above, the Comparison Case would result in greater disturbance of previously undisturbed lands associated with expansion of the stockpile footprints and borrow pits. The increase in SSE area would be associated with revegetation of the stockpile out slopes. Undisturbed lands may have significantly greater inherent value than the reclaimed lands.

1.4 Fundamental Model of Reclamation Challenges

The primary reclamation challenges at Chino involve the control of water and stabilization of the mining by products. This simple concept is extremely complex in practice and the development of the proposed plan has required the coordinated efforts of a diverse group of scientists and engineers. The plan relies on the application of standard reclamation principles to the unique set of conditions that characterize the Chino Mine.

Consistent with industry practices at large open pit copper mines, the proposed plan uses selectively located vegetated soil covers and surface and subsurface water management systems to stabilize the mining wastes and control water quality. These practices are selectively combined to optimize the reclamation and provide efficient, long-term achievement of the environmental standards. Figure 1-3 shows a simplified representation of major water flows and management systems at the Chino Mine.

To support the development of the plan, environmental scientists and engineers have performed extensive, site-specific field investigations to develop a comprehensive understanding of the environment. In addition, specialized studies were conducted to evaluate the implications of closure alternatives. Specifically, Chino has analyzed:

- a) Cover studies for the stockpiles and tailing ponds
- b) Seepage and geochemical flow models
- c) Groundwater flow models

The cover studies include evaluations of the soil water relations, runoff and erosion predictions and vegetation requirements. This information is used to help understand the water treatment requirements. Because some of the surface water and seepage will require treatment prior to discharge, provisions have been included for a water treatment plant capable of processing an average of 1,000 gpm.

The stockpile seepage model addresses flow from the stockpile units and mass loading of dissolved constituents at the base of the stockpiles. The model does not take into consideration the partitioning of the stockpile basal flow/mass loading into seepage that emanates at the toes of the stockpiles and that which infiltrates into underlying bedrock.

The groundwater flow model for Chino's north area (pit and stockpiles) indicates that the Chino pit will be a perpetual hydraulic sink. This means that groundwater in areas in the vicinity of the pit will flow by gravity toward the pit from all directions. Seepage from stockpiles located within the hydraulic sink due to infiltration of incident precipitation and residual draindown will report to the pit. Interceptor wells will be installed as needed below the stockpiles located outside of the pit capture zone to extract impacted water outside of this zone. The results of the stockpile regrading analysis indicate that approximately 90% of the ultimate stockpile areas

are outside of the pit capture zone under the proposed plan.

Engineered channels and ponds will be employed to segregate impacted water from clean water. The impacted water will be treated, while the non-impacted water will be discharged in an approved manner. This will allow the best use of water resources and minimize water treatment costs.

Under the proposed plan, sumps will be employed in the pit to minimize accumulation of water and prevent the formation of a pit lake. Water from the sumps will be pumped to the water treatment plant as needed to maintain desired water level in the sumps. Measures will be taken to ensure that wildlife are precluded from the pit sumps. Future reclamation plans may change this strategy by demonstrating that bioremediation and other treatment technologies would achieve suitable water quality for a permanent pit lake.

Figure 1-3 shows a simplified cross section through the Chino Mine. Tailing ponds are excluded from this sketch due to scale limitations and their location at the southern end of the Permit area.

1.5 Proposed Plan and Comparison Case

The major components of the proposed reclamation plan and the agency-requested comparison plan are listed below. A detailed discussion of the plan is provided in Sections 5 and 6.

1.5.1 The proposed plan is characterized by the following:

- a) Stockpile out slopes remain at angle of repose (approximately 1½ horizontal to 1 vertical, or 1.5:1) and are not covered.
- b) Tailing ponds out slopes remain at between 3:1 and 6:1 and are covered with 24" of suitable material.
- c) Tailing ponds top surfaces are graded if and as required to achieve drainage.
- d) Tailing ponds top surfaces are covered with 18" of suitable material.
- e) Existing stockpile sloping top surfaces are covered with 24" of suitable material.
- f) All sloping top surfaces are bermed as required to achieve proper drainage with minimum erosion.
- g) The out slope surface drainage systems are designed to minimize water treatment. Any impacted stockpile out slope runoff will report to water treatment plant. Non-impacted water will transfer to state approved discharge.
- h) Pit sumps rather than pit lakes are employed.
- i) Stockpile seepage reports to water treatment.
- j) Non-impacted water from interceptor wells reports to state approved discharge.
- k) Impacted water from interceptor wells reports to water treatment.
- l) A water treatment plant using chemical precipitation will treat 1000 gpm.

- m) Covered/capped surfaces are revegetated to establish a self-sustaining ecosystem.

1.5.2 The comparison case is characterized by the following:

- a) Stockpile outslopes are pushed-down to an average slope of 4:1 (3:1 slopes plus benches for overall slope of 4:1 between uppermost crest and lowermost toe) and covered with 36" of suitable material.
- b) Tailing ponds outslopes remain at between 3:1 to 6:1 and are covered with 36" of suitable material.
- c) Tailing ponds top surfaces are graded if and as required to achieve drainage.
- d) Tailing ponds top surfaces are covered with 36" of suitable material.
- e) Existing stockpile sloping top surfaces are covered with 36" of suitable material.
- f) All sloping top surfaces are bermed as required to achieve proper drainage with minimum erosion.
- g) The outslope drainage systems are designed to intercept non-impacted water and minimize water treatment.
- h) Groundwater entering the base of the pit will be pumped to a treatment plant. Pit capture zone will be maintained.
- i) Stockpile seepage requiring treatment reports to water treatment plant.
- j) Non-impacted water from interceptor wells reports to approved surface discharge area.
- k) Impacted water from interceptor wells reports to water treatment plant.
- l) A water treatment plant using chemical precipitation will treat 1000 gpm.
- m) Covered/capped surfaces are revegetated.

1.6 Tailing Cover Study Parameters

Assuming the length of slope and soil material type, for flatter slopes, the rate of soil erosion will be less. To minimize erosion, steeper slopes generally require rockier soil. An important first step is to establish vegetation on a newly graded slope. The design proposed herein employs dozer divots to firmly establish native species. A dozer places the divots at 50 feet on center as it ascends the slope (in backward mode) with immediately adjacent rows also at 50 feet on center, but offset some 25 feet to create a cascading effect. The divots are the width of the blade and from 4 inches to 6 inches deep. Over time, these divots will infill to produce a more typical terrain.

For erosion considerations, top surfaces need less cover than outslopes, assuming the layer is appropriate for vegetation. Similarly, the top of outslopes require less cover than bottom of outslopes where water velocities are greater.

1.6.1 Proposed Plan Design

- a) 18" top surface cover.

- b) 24" average outslope cover, constant thickness or thickness varying from 18" at top to 36" at bottom.

This case provides sufficient theoretical thickness for water retention, vegetation, and acceptable soil erosion rates. The benefits of long term soil generation that is likely to occur have not been considered in the calculations, so they should be conservative.

1.6.2 Comparison Case Design

- a) 36" thick cover on top surfaces and outslopes.
- b) 36" thick cover on outslopes.

This case provides sufficient theoretical thickness for water retention, vegetation, and acceptable soil erosion rates. As with the proposed plan, any long term soil generation has been conservatively neglected. This case creates larger borrow pits, consumes more soil resources, and uses considerably more diesel fuel during construction (approximately 1 to 2 gallons per 10 cubic yards for earth moving equipment).

1.7 Stockpile Cover Study Parameters

Angle of repose slopes composed of large rock clasts will be little affected by sheet and rill erosion processes associated with incident precipitation. If slopes are pushed-down, rhyolite is available as a cover material. In both scenarios, seepage from stockpiles is likely to be less than 20% of total water treatment requirements.

1.7.1 Proposed Plan Design

- a) 24" top surface cover.
- b) No cover on 1½:1 outslopes.

Assuming rhyolite material, this case provides theoretical thickness for water retention, vegetation, and acceptable soil erosion rates. In all cases, more stockpile water would report to toe seeps than to groundwater for angle of repose stockpiles.

1.7.2 Comparison Case Design

- a) 36" top surface cover.
- b) 36" cover on 4:1 outslopes.

This case requires greater volumes of soils, creates larger borrow pits and uses more diesel during placement. Because the area of the stockpile increases relative to the proposed plan, the amount of precipitation falling on the stockpiles is greater when the slopes are flattened. With the flatter slopes, a greater percentage of stockpile seepage water would discharge to ground water.

1.8 Post Mining Land Uses

Two post mining land uses are proposed:

- a) Transition of shops and non-process buildings to an industrial/commercial complex, and
- b) Establishment of wildlife habitat.

1.9 Discussion of Cover and Seepage Models

1.9.1 Tailing Ponds

Stormwater runoff from covered tailing ponds is non-impacted water. Any toe seepage reporting to the ground surface from tailing ponds is considered negligible; i.e., evaporation will be more than sufficient to dissipate any seeps, which are therefore not expected to occur. Significant (measurable) percolation from the tailing mass into ground water is anticipated under both the proposed plan and the comparison case as water currently retained in the tailing drains over a period of several decades.

1.9.2 Stockpiles

A computer modeling approach reportedly approved by the MMD and NMED has been used to predict water flow. A third party audit has resulted in discussion concerning the required degree of complexity and specificity. Without testing of initial reclamation areas to calibrate hydrological parameters, more scientific modeling is likely not warranted. To compensate for any potential differences in modeling versus actual, the water treatment plant proposed herein is oversized; i.e., more expensive than theoretically needed.

1.9.3 Miscellaneous Areas

This category includes building demolition, utility corridors, reservoirs, exploration roads, etc. The proposed plan has 18" of cover and the comparison case has 36" of cover.

1.10 Water Management System including Groundwater Model

In general, effective water management (source control) is preferred to water treatment. However, the water treatment methods proposed herein are proven and will allow for the responsible management of impacted waters both during and following the completion of reclamation activities described in the proposed plan.

- a) Non-impacted surface runoff is kept separated from potentially impacted sources and discharged to an approved surface discharge area by gravity in accordance with state regulations.
- b) A retention pond(s) is placed in the higher levels of the pit, where the relative proportion of pyritic wall rock is lower than deeper in the pit, to collect non-impacted wall runoff. This water will be discharged by pumping in accordance with state regulations.
- c) Stockpile seeps will be collected and pumped to tanks or ponds for testing. Compliant water will be discharged in accordance with state regulations. Impacted water will report to water treatment.
- d) Stockpile outslope runoff (Proposed Plan only) will be collected and report to tanks or ponds for testing. Compliant water will be discharged in accordance with state regulations. Impacted water will report to water treatment.
- e) Impacted interceptor well water will be sent to water treatment.
- f) Pit water will be limited to an pit floor sump. Pit drawdown water will report to water treatment.
- g) Tailing pond toe seeps (if present) will report to water treatment.
- h) Irrigation will be accomplished with commingled sources.

1.11 Water Treatment Alternatives

The following evaporation and treatment options were considered for New Mexico closures.

1.11.1 <u>Evaporation Options</u>	<u>Treatment - Purpose</u>
Natural Evaporation	None – Remove Water
Forced Evaporation	None – Remove Water
1.11.2 <u>Treatment Options</u>	<u>Treatment - Purpose</u>
Chemical Precipitation Process	Remove Metal Ions, Fluorides, TDS & Sulfates – Discharge Water to Environment
Adsorption Process	Remove Fluorides – Discharge Water to Environment
Ion Exchange	Remove Sulfates – Discharge Water to Environment
Membrane Technology	Remove Total Dissolved Solids (TDS) – Discharge Water to Environment

Bioremediation

Remove Metal Ions & Sulfates –
Discharge Water to Environment

1.11.3 Irrigation

Commingling of Water Sources

1.11.4 For this CCP, chemical precipitation is used for water treatment. This is more costly, resulting in higher financial assurance than the more likely future option of in-situ bioremediation, but is both proven and demonstrated technology. Considerable laboratory testing has been carried out to verify the chemical precipitation selection for the water at Chino.

Treated water and fresh water are then commingled with interceptor well water to provide a blended water stream that complies with NMWQCC regulations. This is then discharged to a greenbelt via irrigation.

1.11.5 Approximately 1,000 gpm of treated water will be commingled with up to 5,500 gpm of interceptor well water and potentially impacted water to furnish a water source.

1.12 Summary of Financial Assurances

1.12.1 Developed Data

Capital costs, operating costs and maintenance costs have been developed for the plans as outlined. In accordance with the ENR (Engineering News Record) Cost Index for construction during the past five years, a 2.55% annual inflation rate has been used.

1.12.2 Schedule

A Project Schedule has been developed for closure based on:

- a) Capacity of available contractors.
- b) Integral values of life cycle for equipment (e.g., one or two fleets of dozers are completely written off during life of project).
- c) Extended leach life of stockpiles after the cessation of active mining operations (i.e., much of the cost of obtaining copper is associated with mining and placing on stockpiles, thus, copper can be produced at a comparative low cost by a bonding company or any assuming operator).
- d) A preference to receive test results from initial reclamation efforts before finalizing construction techniques.

1.12.3 Calculation of Financial Assurance

Costs for the financial assurance calculations are presented in Section 9.

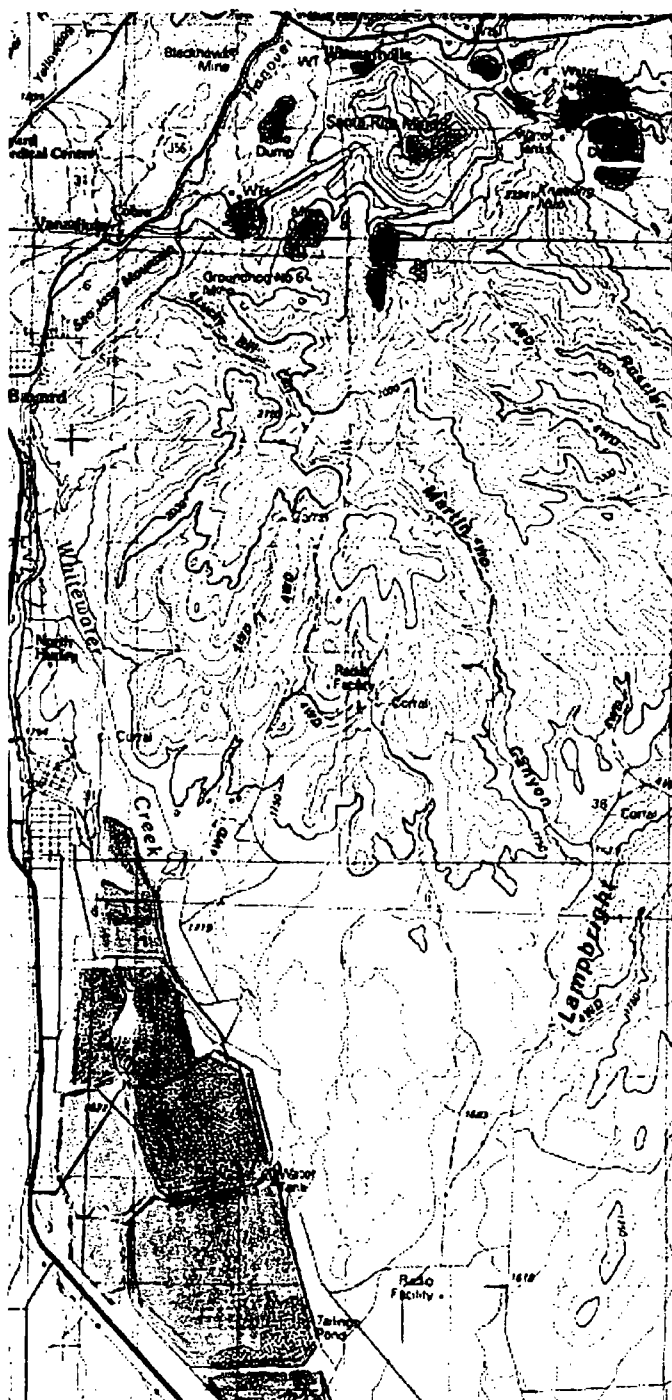
Proposed Plan Total Costs:	\$98,913,341 – No Escalation
Comparison Case Total Costs:	\$251,641,487 – No Escalation
Proposed Plan Total Costs:	\$130,423,451 - 2.55% Escalation
Comparison Case Total Costs:	\$318,201,041 – 2.55% Escalation

1.13 Degree of Engineering and Scientific Development

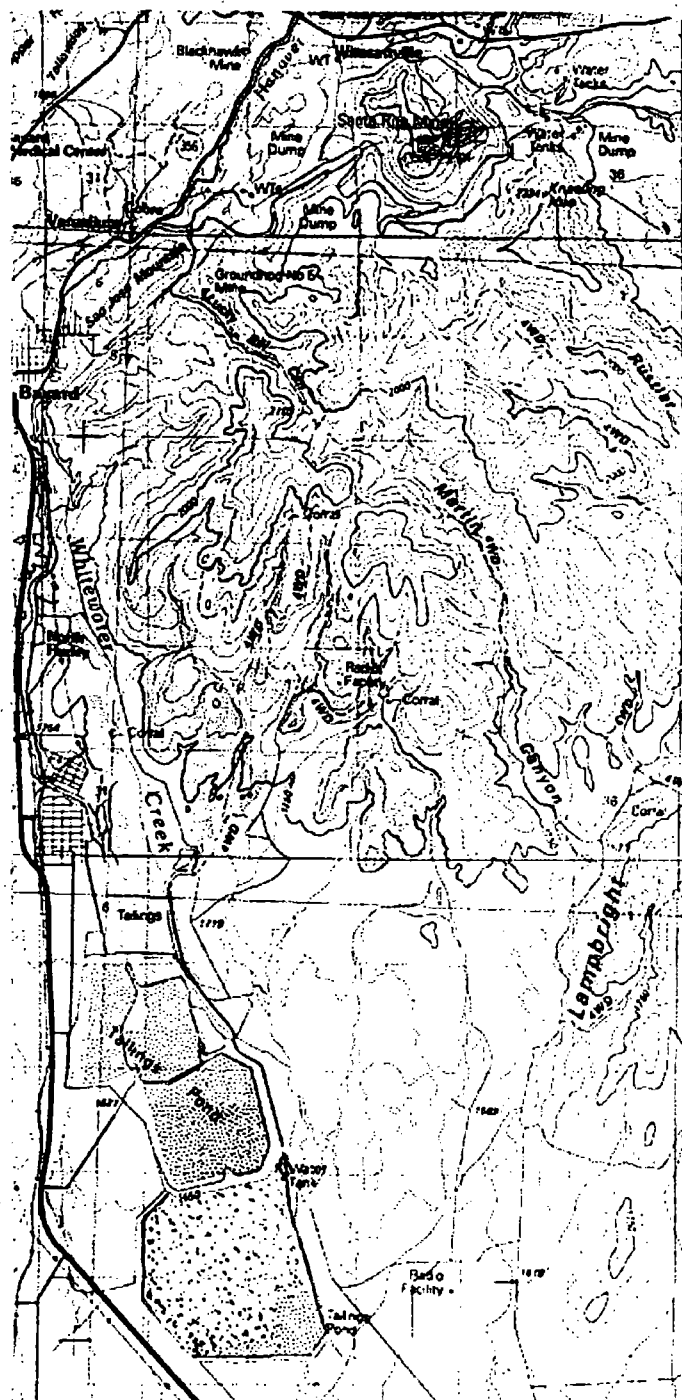
The purpose of this CCP is to present and technically define the design criteria for reclamation and closure of the Chino Mine permit area to a point that an upper limit for costs can be established. Chino plans to update the report periodically (e.g., every five years). This report addresses various technical and regulatory issues raised by the MMD and the NMED since CCP development began in the early 1990's at Chino.

Obviously, scientific development and engineering detailing can be much further advanced than has presently been carried out by a number of parties - including the highly qualified consultants used to date. Such costly development is not warranted if it does not materially impact the bond amount. In general, modeling and detailing has been carried out sufficiently to capture upside costs.

Finalized engineering at a later date is the intent of the applicable regulations. This is reflected in requirements by MMD/NMED for both detail engineering and construction management costs to be included in the bond amount (approximately \$4,200,000 for proposed plan and approximately \$14,600,000 for comparison case) as well as state administrative costs (approximately \$900,000 for proposed plan and approximately \$3,100,000 for comparison case).

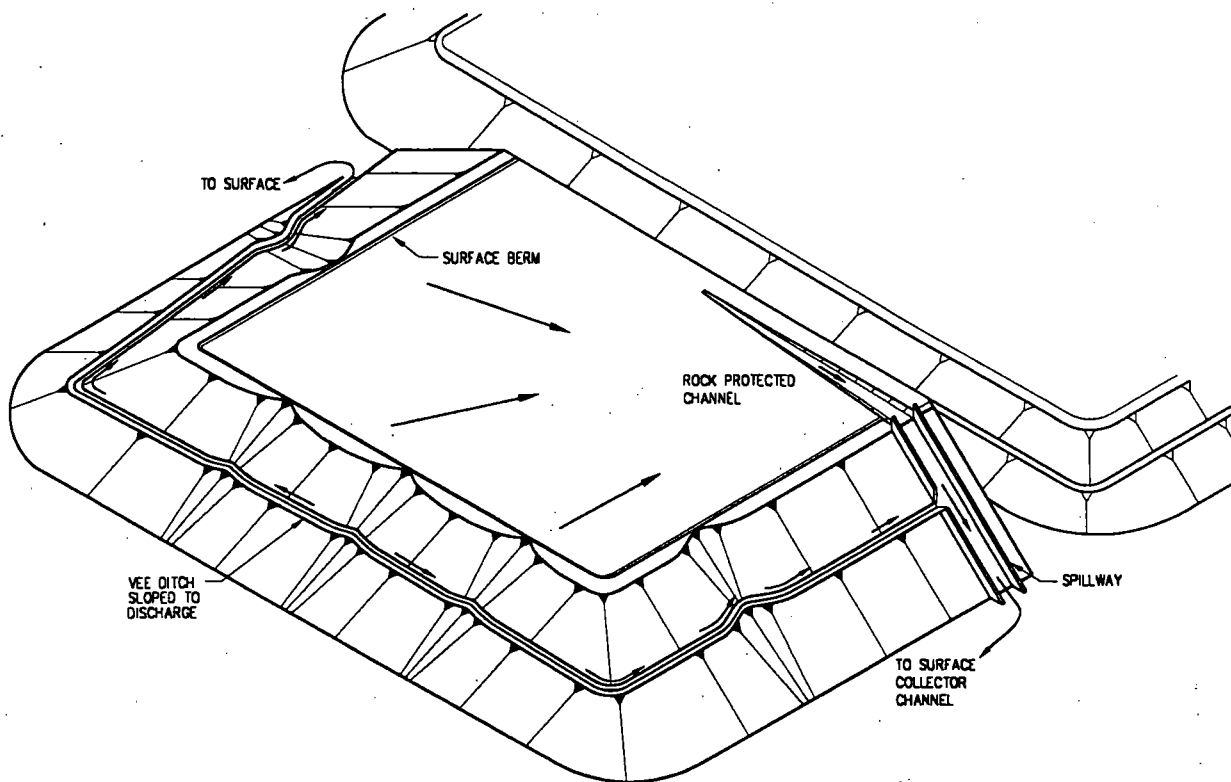


Proposed Reclamation Plan

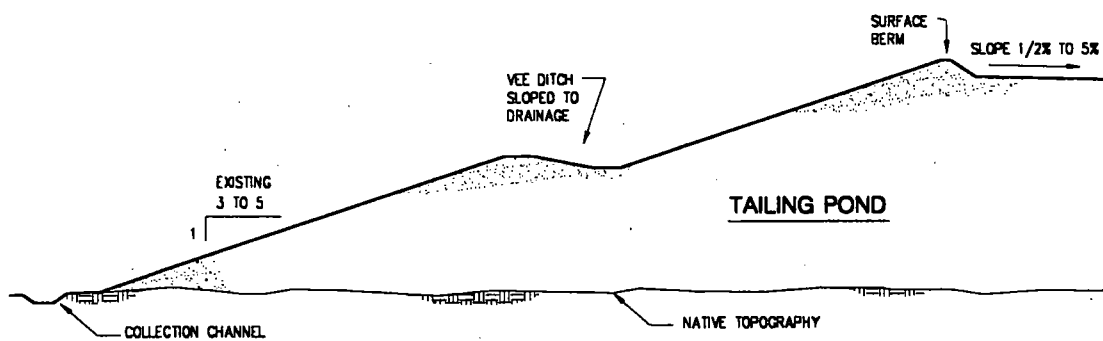


Existing Mining Facilities

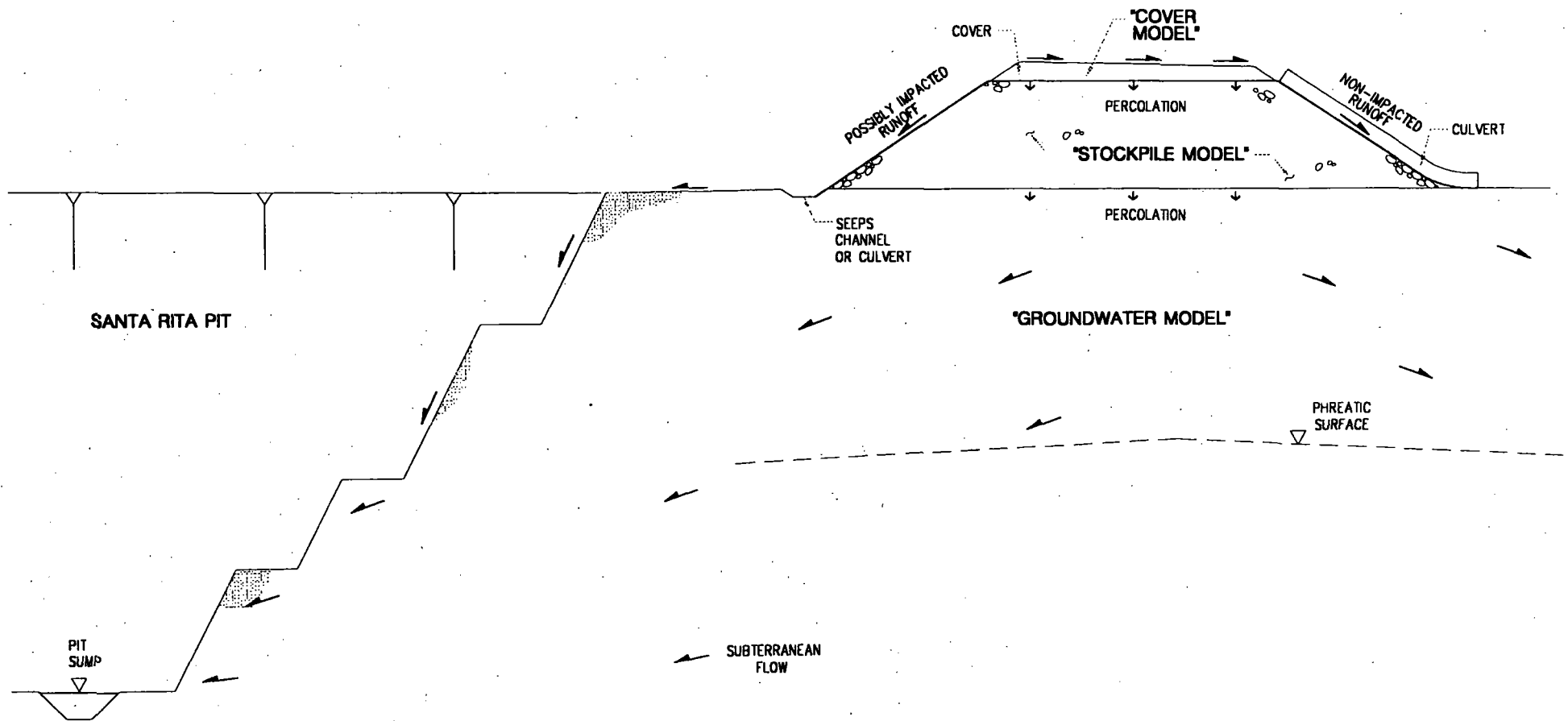
Figure 1-1



TYPICAL TAILING POND - CONCEPTUAL PERSPECTIVE



TYPICAL TAILING POND - SECTION



CONCEPTUAL WATERFLOW MODELS

Figure 1-3

2. Existing Facilities and Conditions

This report document presents the Closure/Closeout Plan for Chino Mines Company (Chino). The Chino Mine is an open pit copper mine, concentrator, and solution extraction-electrowinning (SX/EW) plant located approximately 10 miles east of Silver City in Grant County, New Mexico (Figure 2-1).

Recent correspondence between the State of New Mexico and Chino has resulted in a coalescing of facility terminology. This report maintains the original and more extensive listing of facilities. For reference, this recent renaming is listed below:

<u>This Report Listing</u>	<u>Reorganized Names</u>
South Stockpile	South Stockpile
Upper South Stockpile	South Stockpile
West Stockpile	West Stockpile
North Stockpile	North Stockpile
Northeast Stockpile	North Stockpile
Northwest Stockpile	Borrow Area
North Lampbright	North Lampbright Stockpile
Main Lampbright	Main Lampbright Stockpile
South Lampbright	Main Lampbright Stockpile
Southwest Lampbright	Main Lampbright Stockpile

2.1 Regulatory Authority

In 1993, the New Mexico legislature enacted the New Mexico Mining Act requiring that closeout plans be put in place for mines within the state. Rules to implement the requirements of the Act were promulgated in 1994.

In accordance with the New Mexico Mining Act (NMMA) and Rules and New Mexico Water Quality Control Commission (NMWQCC) Regulations, M3 Engineering & Technology Corporation (M3) has prepared this closure/closeout plan for closure and closeout of the Chino Mine following cessation of mining and associated processing operations.

Chino is submitting the closure/closeout plan for the Chino Mine to the New Mexico Energy, Mineral, and Natural Resources Department's Mining and Minerals Division (MMD) and the New Mexico Environment Department (NMED).

2.2 History of Closure/Closeout Plan Submittal

In 1994 Chino submitted a mining operations site assessment and an existing mining operation permit application for the Chino Mine. The permit application was approved by the MMD on December 29, 1997.

Chino submitted a preliminary closure/closeout plan report in December of 1997.

Chino applied for and was granted an extension by the New Mexico Energy Minerals and Natural Resources Department's Mining and Minerals Division (MMD) for closeout plan approval until December 31, 1999.

Chino submitted a revised closure/closeout plan report in 1999. Based in part on this report, Chino secured an interim financial assurance bond with the NMED

Also in 1999, Chino applied for and was granted an additional extension for closeout plan approval until December 31, 2001.

2.3 History of Mining at Chino

The Chino (Santa Rita) copper deposits were known to the Apache Indians. The Spanish learned of the deposits by the 1770s and began development of the Santa Rita copper deposits in the early 1800s, when a land concession for the area was granted to Don Francisco Elguea. Through most of the 1800s, the mine was leased from Elguea and his heirs, although Apache Indians prevented continuous working of the mine. Early mining methods used underground shafts that followed the larger ore bodies. Mined ore was transported to Mexico.

In 1909, the Chino Copper Company was formed and assumed ownership of the mine. Open pit mining operations at Santa Rita began in 1910 and have continued and expanded to the present. In 1911, the Chino Copper Company constructed a mill and concentrator near the current Hurley Smelter site, to which the ore was transported from Santa Rita by rail for flotation processing. Ore that was not suitable for the flotation process was stockpiled near the pit, and tailing from the concentrator was deposited east and south of Hurley along Whitewater Creek. Construction of the Hurley Smelter was completed in 1939. In mid-1982 the Hurley mill and concentrator were replaced by a new mill and concentrator (together called the Ivanhoe Concentrator) located closer to the open pit.

In 1936, Chino started leaching operations of the low-grade ore stockpiles near the open pit. Copper was extracted from the resulting leach solutions at precipitation plants. In 1988, the SX/EW plant was constructed just east of the open pit and additional leaching activities began in permitted areas.

Mining currently takes place on a three-shift-per-day, seven-day-per-week basis. Rock is fragmented using conventional drilling and blasting techniques. After blasting, the materials are loaded into haul trucks for delivery to the appropriate destination.

- Sulfide ore with a copper content above mill cutoff grade is delivered to the primary crusher west of the pit and then to the Ivanhoe Concentrator for processing.
- Leachable ore is delivered to leach stockpiles around the periphery of the pit and in Lampbright Draw.
- Low-grade leach ore is stockpiled south of the pit.
- Overburden and waste rock are stockpiled in several locations around the pit.

Figure 2-2 describes ore processing operations used since 1982.

2.4 Past and Current Land Uses

Mining has been the principal land use and land-based economic support for the area since open-pit mining began in 1910. Surrounding lands have a variety of uses including residential, commercial, industrial, grazing, timber, and recreation. Agriculture has not been pursued on a large scale in this area due to the relatively dry climate, varying topography, and poor soil conditions.

2.5 History of Land Ownership

The Chino mine permit area consists primarily of private land owned by Chino, along with areas of federal lands managed by the Bureau of Land Management (BLM).

Except for the Kneeling Nun area, Chino controls the mineral rights on all BLM land within the mine permit area through unpatented mining claims.

The ownership of the Chino Mine property from the time of the Elguea concession through the present day is summarized as follows:

- Through most of the 1800s, control of the Santa Rita copper deposits was in the hands of Don Francisco Elguea and his heirs.
- In the late 1800s, title to the property changed hands twice before the Santa Rita Mining Company purchased the property in 1889.
- The Chino Copper Company was formed in 1909 and assumed control of the property. In the mid-1920s, Chino Copper Company merged with Ray Consolidated Copper Company and later with Nevada Consolidated Company to form Nevada Consolidates.

- In 1933 Kennecott Copper Corporation purchased Nevada Consolidates and the Santa Rita Mine.
- In the face of declining copper prices, Kennecott Copper Corporation sold a one-third interest in the Santa Rita mine to Mitsubishi Corporation in 1980 and the remaining two-thirds interest to Phelps Dodge Corporation in 1986.

2.6 Environmental Setting

For the purposes of closure/closeout, the Chino Mine has been separated into two geographical areas:

- The North Mine Area includes the open pit and surrounding terrain along with Whitewater Creek to the north end of Lake One.
- The South Mine Area encompasses the tract from the north end of Lake One to the confluence of Whitewater Creek with San Vicente Arroyo, approximately 12 miles to the south.

Sections 2.6.1 through 2.6.7 summarize various aspects of the mine site, including its topography, geology, climate, hydrology, soils and vegetation, wildlife, and material characteristics.

2.6.1 Topography

Because of its general location near the Cobre and Pinos Altos Mountains of southwestern New Mexico (Figure 2-3), the topography at the Chino Mine ranges from hilly to mountainous in the North Mine Area to relatively flat in the South Mine Area. The original topography at the site has been significantly altered as a result of mining activities. The specific topographies of the North and South Mine areas are described in Sections 2.6.1.1 and 2.6.1.2, respectively.

2.6.1.1 North Mine Area Topography

Major topographic features of the North Mine Area include the Cobre Mountains and the San Vicente Basin. Erosion of the plateau surface in the Cobre Mountains southeast of Bayard has left a series of even-crested, southward-sloping ridges that gradually become low hills. The topographic high within the North Mine Area is approximately 7,700 feet above mean sea level (msl).

The San Vicente Basin is a broad lowland that extends southward from the Mimbres Valley. The basin terminates

against the Big Burro and Little Burro Mountains on the west, the Silver City and Pinos Altos Ranges on the north, and the Cobre Mountains on the east. The terrain slopes from these mountains toward San Vicente Arroyo, which runs along the long axis of the basin. The San Vicente Basin is characterized by numerous arroyos that are tributary to San Vicente Arroyo.

The Mimbres River drains the eastern slopes of the Pinos Altos and Cobre Mountains. San Vicente Arroyo and Whitewater Creek drain the San Vicente Basin and adjacent slopes between the Big Burro and Cobre Mountains.

The topography of the North Mine Area consists of ridges and southeast-to southwest-trending drainages. Slopes range from 3 to 5 percent on the ridge tops to 65 percent on hillsides. The steeper slopes are rock outcrops and cliffs associated with the Kneeling Nun Tuff. The natural ground surface elevation ranges from 6,600 to 7,700 feet above msl.

The Santa Rita pit in the North Mine Area is located at the historical headwaters of Whitewater and Santa Rita Creeks. Stockpiles of mined material discontinuously cover the pre-mining topography on the south through west portions of the north and east edges of the pit.

2.6.1.2 South Mine Area Topography

The South Mine Area is situated on the northeast margin of the San Vicente Basin. Major topographic features in this area are low hills that ascend to the northeast toward the Cobre Mountains.

Mining activities have also changed the topography of the South Mine Area. Seven tailing ponds within this area partly overlie the original channel of Whitewater Creek, a generally southward-flowing intermittent stream, and extend to the West onto a gently southward-sloping surface termed the Hurley Plain. At the northern edge of the Hurley Plain the natural ground surface elevation is about 5,775 feet above msl, while at the southern toe of Tailing Pond 7 it is approximately 5,275 feet above msl. The maximum local relief in the area is approximately 125 feet, occurring at the southern margins of Tailing Ponds C and 6.

2.6.2 Geology

The Chino Mine is in the southeastern corner of the Central Mining District. Chino, the largest copper mine in New Mexico and among the oldest in the United States, is set in a complex geologic setting in the transition zone between the Colorado Plateau and the Basin and Range physiographic provinces. The following sections describe the geology of the ore deposits in and around the Santa Rita pit in the North Mine Area and unmineralized rocks and sediments in the South Mine Area.

2.6.2.1 North Mine Area Geology

The Chino or Santa Rita deposit is a porphyry copper body that includes intrusive and skarn-hosted copper mineralization. Mineralization is associated with a generally porphyritic composite intrusion varying in composition from granodiorite to quartz monzonite that has domed surrounding Paleozoic and Cretaceous sedimentary rocks during the early Tertiary. The sedimentary section was also intruded by late Cretaceous quartz diorite sills that predate the main stock intrusion but are not believed to be associated with mineralization. Post-mineralization, mid-Tertiary volcanic rocks were extruded over the deposit and included rhyolitic tuffs and basaltic andesite flows.

Sedimentary rocks in the area include Paleozoic sandstone, limestone, dolomite, and shale. The lower portion of the Cretaceous and all of the Triassic and Jurassic sections are not represented in the area, presumably because the region was a topographic high during these periods, thus accounting for the disconformity between the Permian and upper Cretaceous rocks. The upper Cretaceous rocks include sandstones, siltstones, shales, and minor shaley limestones of the Colorado and Beartooth Formations.

Hydrothermal alteration and mineralization is associated with the intrusion of the Santa Rita composite stock, which has been dated by $^{40}\text{Ar}/^{39}\text{Ar}$ methods at between 58.1 and 59 million years old. The stock intruded at the junction of three sets of faults, including pronounced northwest and northeast sets and a less prominent easterly set. The stock is elongated in a northwest-southeast direction. Abundant mineralized fractures show that the stock was intensively fractured and hydrothermally altered following solidification. Types of non-skarn alteration include potassium feldspar, biotite, quartz-sericite-pyrite and argillic.

Three ages and compositions of dikes cut the intrusion. Granodiorite is the oldest and occurs as early apophyses of the stock into the surrounding rocks and as late dikes cutting the stock. Later intrusive rocks include dikes of quartz monzonite and latite, both of which have been dated by $^{40}\text{Ar}/^{39}\text{Ar}$ methods at about 56 million years old, but cross-cutting relationships show the latite to be the youngest dike phase. The latite is not mineralized; the quartz monzonite is rarely mineralized, but usually not to ore grade.

Pennsylvanian and Mississippian sedimentary rocks, primarily limestone, that were invaded by the magma were completely altered and replaced by calc-silicates and associated contact metasomatic minerals. Common skarn minerals associated with these rocks include magnetite, pyrite, quartz, garnet, epidote, actinolite, and chalcopyrite.

Chalcopyrite is the primary hypogene copper mineral in both skarn and unenriched intrusive rocks. Without secondary chalcocite enrichment, however, little other than the skarns would be of ore grade. Cretaceous clastic sedimentary rocks and the quartz diorite porphyry sills within surrounding sedimentary rocks are also secondarily enriched, frequently to ore grade. The upper Paleozoic rocks, though extensively altered, were typically reactive to descending supergene solutions and, consequently, not greatly susceptible to secondary enrichment. Oxidation of chalcocite has commonly resulted in the formation of native copper, cuprite, and chrysocolla and more rarely azurite, malachite, turquoise, and libethenite (copper phosphate).

Post-mineralization (mid-Tertiary) volcanic rocks overlie the southern and southeastern portion of the deposit and probably initially overlaid the entire deposit. These rocks include the Sugarlump and Kneeling Nun Tuffs. The tuffs are overlain, in places, by basaltic andesite lava flows. These volcanic rocks crop out over a large portion of the area south and east of the Santa Rita pit. The Sugarlump Tuff is 50 to 100 feet thick and in the mine area is a poorly consolidated, non-welded tuff that typically forms slopes. The 400- to 600-foot-thick Kneeling Nun Tuff is a very strong, massive, welded tuff, easily identified because it is a cliff former in the area south of the mine. Basaltic andesite flows overlying the tuffs reach a thickness of up to 500 feet; but are typically 200 to 400 feet in the mine area. These mid-Tertiary units are not mineralized, and are only removed

during mining to facilitate access to mineralized material at depth to the north and northwest.

A number of major fault systems underlie the North Mine Area:

- Hanover Creek Fault, trending north-northeast along Hanover Creek
- Copper Glance Fault, a series of north-northeast-trending faults crossing upper Whitewater Creek
- Bayard Fault, trending north-northeast along upper Whitewater Creek north of Bayard
- Groundhog Fault, trending northeast from the south end of Bayard along Bayard Canyon

2.6.2.2 South Mine Area Geology

Only Tertiary and Quaternary strata are exposed at the surface of the South Mine Area, although a small outcrop of limestone, possibly belonging to the Paleozoic Oswaldo Limestone, occurs outside the area, west of Tailing Pond B.

Borehole data indicate that Precambrian granite, gneiss, and schist exist in the subsurface at depths usually greater than 2,500 feet below ground surface. Paleozoic formations also are present in the subsurface and consist mainly of limestones, dolomites, and subordinate shales and sandstones. The Pennsylvanian Oswaldo Limestone is the youngest Paleozoic rock unit in this area. No Mesozoic sedimentary rocks have been reported in or below the South Mine Area, although a 265-foot thickness of the Cretaceous Tertiary Hurley Sill (hornblende latite) was penetrated in a borehole located just east of Whitewater Creek at the latitude of the Hurley Smelter.

The Hurley Sill and Oswaldo Limestone are unconformably overlain by the mid-Tertiary Rubio Peak Formation, which in the South Mine Area subsurface typically comprises 200 to 300 feet of conglomerate and rhyolitic tuff and ash-flow tuff. The Sugarlump Tuff rests on the Rubio Peak Formation and is made up of about 600 feet of rhyolitic to andesitic tuffs, ash-flow tuffs, and tuffaceous sedimentary rocks. Overlying the Sugarlump Tuff is the Kneeling Nun Tuff, a pink to grayish-pink ash-flow tuff exposed in the hills east of the South Mine Area, where it is a cliff former with a maximum thickness exceeding 400 feet.

Stratigraphically above the Kneeling Nun Tuff and exposed outside of the South Mine Area are four other mid-Tertiary volcanic or volcanoclastic units.

In the vicinity of the South Mine Area, the Miocene to Pleistocene Gila Conglomerate is inferred to unconformably overlie the Kneeling Nun Tuff and older Tertiary and Paleozoic stratigraphic units. The Gila Conglomerate is more than 560 feet thick in one boring and consists mostly of poorly sorted conglomerate, with local beds of sandstone and mudstone. The unit is usually poorly consolidated and poorly cemented in outcrop, becoming increasingly lithified and cemented with depth.

In the interceptor well field immediately south of Tailing Pond 7, the Gila Conglomerate can be subdivided into two units. The lower unit is a finer-grained, more consolidated, and bore more volcanic rock clasts than the upper unit. Toward the southwest, basalt up to 75 feet thick is found at the top of the lower unit. The maximum thicknesses of the upper and lower units exceed 300 feet and 140 feet, respectively.

The Gila Conglomerate is overlain by Quaternary sediments that are as much as 50 feet thick and consist predominantly of alluvial sand and gravel. They can be distinguished from the Gila Conglomerate only by their lower degree of consolidation and cementation.

Structural features in the South Mine Area include the Silver City Fault, which is located south of Tailing Pond 7 and trends northwest from Faywood to Silver City. Geophysical data indicate a potentially significant offset within Gila sediments along the trend of this fault. This offset may be related to a perched zone of saturated coarse gravel intersected in a monitor well located near the trace of the fault. Other minor faults and folds have been noted within or near the South Mine Area, but none are believed to significantly affect the surface or subsurface hydrologic regime in the area.

2.6.3 Climate

The Chino Mine is located in a semiarid region in southwestern New Mexico. Topography plays a key role in determining precipitation amounts, storm intensities, and storm durations. Elevations across the site range from less than 5,200 feet above msl along Whitewater Creek to 7,704 feet above msl approximately one mile south of the Kneeling Nun

monolith. In general, temperatures decrease and humidity and precipitation increase as elevation increases.

Daily temperature and precipitation data are collected at three locations within the vicinity of the mine. Long-term records are available from the Santa Rita meteorological station (located in the north area of the Santa Rita pit), Fort Bayard (located 3 miles northwest of the former precipitation plant), and the town of Hurley (located about 7 miles south of the pit area). Periods of record for each station are:

- Santa Rita: January 15, 1911 to present
- Fort Bayard: Late 1800s to present
- Hurley: January 15, 1912 to present

For the period of record at the Santa Rita meteorological station, the average annual temperature is approximately 54°F. However, the site exhibits a wide range in daily and annual temperatures. The prevailing winds are from the west, except during the months of July, August, and September when prevailing winds are from the southeast, south/southeast and south/southwest, respectively.

Most of the precipitation in the area falls during July through October in the form of rain during short, intense thunderstorms. A limited snow pack forms at higher elevations in the winter and yields some runoff in the spring. However, the greatest precipitation can be expected during summer months when convective activity is at its maximum due to increased differential heating and prevalent subtropical moisture. The highest recorded 24-hour precipitation due to thunderstorm activity was 3.05 inches in July 1969. Data from precipitation records show long-term (86 years) average precipitation to be 14.33 inches per year at Hurley and 17.39 inches per year at Santa Rita (which is 600 feet higher in elevation). For the periods of record, both areas receive approximately 62 percent of their precipitation during July through October.

Other climatic data that are available include:

- Precipitation and Evaporation data from the Tailing Pond 7 climate station
- Precipitation and Evaporation data from the SX/EW climate station
- Precipitation data from the Reservoir 8 climate station

- Precipitation, wind speed/direction, solar insolation, barometric and temperature data from the South Stockpile climate station
- Wind speed and direction from the Golf Course and Geronimo monitoring locations
- Lake evaporation average and evapotranspiration
- Evaporation data from Climgen by the U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) and Forest Service within Water Erosion Prediction Project (WEPP)
- Solar radiation estimates and data set generation from the Hydrologic Evaluation of Landfill Performance (HELP) model

The following meteorological data have been loaded into the Chino database:

- Monthly rainfall data from the Hurley (January 1912 through May 1995) and Santa Rita (January 1911 through May 1996) stations
- Half-hourly temperature, wind direction, and wind speed measurements from the Golf Course and Geronimo monitoring locations (January 1989 through September 1996)
- Half-hourly barometric pressure data from the Weather Tower monitoring location (January 1989 through September 1996).

2.6.4 Hydrology

The hydrology of the Chino Mine area is typical of semiarid regions, with no large surface water bodies. A brief summary of surface water and groundwater hydrology at the mine is provided in Sections 2.6.4.1 and 2.6.4.2, respectively.

2.6.4.1 Surface Water

The surface water hydrology of the Chino Mine is typical of high desert regions in New Mexico, with ephemeral and intermittent streams that have peak discharges associated with summer convective storms. This fluvial system drains to the south and is included in the Mimbres River watershed. The major drainages at Chino include Whitewater Creek, Hanover Creek, and Lampbright Draw (Drawing Chino-01, Appendix B).

Whitewater Creek is an intermittent stream and represents the primary trunk stream draining the North and South Mine Areas. Hanover Creek is a major tributary to Whitewater Creek, which eventually joins San Vicente Arroyo south of the mine. The headwaters of Whitewater Creek have been altered by mining activities, and runoff from the upper part of the watershed is intercepted by a reservoir, and consequently, Whitewater Creek now originates immediately west of Reservoir 17 and flows southwest to the South Mine Area.

The lower reaches of Whitewater Creek have been modified in association with the development of the tailing ponds. The historical channel of Whitewater Creek flowed in the area now occupied by portions of Lake One and Tailing Ponds 1, 2, 4, 6 and 7. In 1910, Whitewater Creek was originally dammed to form Lake One and later (1911) diverted to flow east of Pond 1. In 1919, Axiflo Lake was constructed immediately south of Tailing Pond 2. Axiflo Lake is still in use, while Lake One is dry. Additional changes in channel location were made in 1984, when the creek bed was moved to the east around Lake One, and in 1988, when the channel was diverted to the east of the planned site for Tailing Pond 7. Whitewater Creek now rejoins its original channel south of Tailing Pond 7.

Hanover Creek is an intermittent stream that originates north and east of the Chino Mine. It flows southwest between Highway 356 and the West stockpile, joining Whitewater Creek near the Ivanhoe Concentrator. Stream flow data for Hanover Creek have been collected since 1989.

Lampbright Draw is an intermittent stream draining the eastern portions of the North Mine Area that has also been altered in its upper reaches by mining activities. A channel was constructed north of the Main Lampbright stockpile to divert stormwater in that area around the stockpile. Lampbright Draw flows south and joins San Vicente Arroyo several miles west of Faywood.

2.6.4.2 Groundwater

Groundwater flow beneath the Chino Mine is generally southerly and follows the surface topography, but groundwater flow in the North Mine Area is affected by mining operations. Specifically, a hydraulic discontinuity occurs at the mine due to dewatering of the Santa Rita pit, which has artificially lowered the potentiometric surface and induced groundwater flow toward the

pit. The regional groundwater gradient for the Chino Mine areas is depicted in Drawing Chino-20, Appendix B.

The complicated subsurface geology of the area, which consists of bedrock, fractured bedrock, alluvium, and man-made features (e.g., stockpiles), adds further complexity to the groundwater flow in the North Mine Area. Aspects of this complexity include:

- Hydraulic conductivity in the bedrock units is highly variable and strongly influenced by fractures. Measured hydraulic conductivities range from 10^{-5} to 101 feet per day (ft/d).
- Groundwater flow is concentrated in fractured portions of the bedrock, but on a regional scale it is thought that these fracture systems are sufficiently interconnected that the bedrock acts as an equivalent porous medium. Water levels in the bedrock range from tens to hundreds of feet below ground surface.
- The data available on the hydraulic conductivity of the alluvium include transmissivity estimates ranging from 2,000 to 23,000 square feet per day (ft²/d). Water levels in the alluvium are shallow and highly responsive to runoff events.
- Because of the construction techniques, stockpile materials are unconsolidated when deposited and may be layered to varying degrees. Layering may develop both within lifts, associated with individual end-dumped deposits, and between lifts due to compaction by mine traffic. Heads within the stockpiles are variable and likely dependent on the hydraulic properties of the underlying units.

Other factors that influence local groundwater flow conditions in the North Mine Area include underground mine workings, reservoirs, cut-off walls, and production wells.

Groundwater recharge at the Chino Mine occurs as a result of the following processes:

- Direct infiltration of precipitation
- Infiltration of storm runoff in stream channels

- Mountain front recharge
- Stockpile infiltration
- Reservoir leakage
- Tailing pond leakage

Regional estimates of mountain front recharge range between 11,000 and 57,000 acre-feet per year, and water balance calculations suggest that about 5 percent of the applied leach or direct precipitation to stockpiles has infiltrated to the underlying bedrock.

Available maps of water table elevations of regional groundwater since the mid-1950s indicate that the overall groundwater flow direction in the South Mine Area is southward to south-southeastward under hydraulic gradients of approximately 0.004 to 0.05 foot per foot (ft/ft).

Four major hydrogeologic units have been delineated in the South Mine Area. In descending order they are the alluvial aquifer, the Gila aquifer, the volcanic aquitard, and the limestone aquifer.

2.6.4.2.1 Alluvial Aquifer

The alluvial aquifer is present in the stream deposits of Whitewater Creek and its tributaries. Alluvium in Whitewater Creek is about 5 to 20 feet thick from Bayard to the area north of Lake One. The alluvium is covered by Lake One sediments and the tailing ponds from the Hurley area to the south end of Tailing Pond 7. The alluvium is also present at the surface along the Whitewater Creek channel south of Tailing Pond 7.

North of Lake One, water levels in the alluvial aquifer commonly rise during and shortly after a runoff event and decline during dry periods. The depth to water is generally 1 to 5 feet below ground surface (bgs), but ranges up to 10 feet bgs. Saturated thickness averages 10 feet but may increase following runoff events. Aquifer tests conducted north of Lake One indicated transmissivities ranging from about 2,000 to 22,700 ft²/d and storage coefficients of 0.01 to 0.06.

2.6.4.2.2 Gila Aquifer

In the vicinity of Lake One and the tailing ponds, the depth to water increases to between approximately 80 and 170 feet bgs and the uppermost aquifer is the Gila aquifer, which underlies the alluvial sediments and shallower perching layers. The thickness of the Gila aquifer ranges from a few feet in places north of Lake One to more than 1,000 feet southwest of the Silver City fault, which is southwest of Tailing Pond 7.

The textures of the sediments in the Gila aquifer vary both vertically and horizontally; hence its hydraulic properties span a wide range. Test data indicate a range of transmissivities of 27 to 133,670 ft^2/d , with a geometric mean of 6,120 ft^2/d . The range of estimated storativities, 0.001 to 0.2, is also wide. Possibly the permeability in the Gila aquifer decreases with increasing depth as a result of downward increases in degree of cementation and consolidation and a decrease in grain size.

Vertical hydraulic gradients have been reported to occur within the Gila aquifer, ranging from 0.05 ft/ft upward to 0.2 ft/ft downward in the area of the older tailing ponds and 0.4 ft/ft downward near the Apache Tejo well field. Vertical gradients at the south end of Tailing Pond 7 vary from 0.1 ft/ft upward to 0.2 ft/ft downward.

In the interceptor well field south of Tailing Pond 7, aquifer tests suggested decreases in hydraulic conductivity within the upper Gila aquifer, both laterally and vertically. The lateral decline occurs from the eastern to the central part of the field, and the vertical decline occurs from the upper to the lower part of the aquifer. In the same area, the east-to-west decline in hydraulic conductivity was also noted. The magnitude of this decrease in hydraulic conductivity was from approximately 40 ft/d in the east to less than 10 ft/d in the west. Based on drilling log data, the reduction was attributed to an eastward decrease in sediment grain size and increase in degree of cementation.

2.6.4.2.3 Volcanic Aquitard

The volcanic aquitard comprises the Rubio Peak Formation and Sugarlump Tuff. It underlies the alluvial aquifer north of Lake One and the Gila aquifer southeast of Lake One and appears to be absent west of the tailing ponds, owing to pre-Gila erosion. Its thickness ranges from a few feet to more than 800 feet in the vicinity of the South Mine Area.

Aquifer test results suggest that the hydraulic conductivities and storage coefficients of the volcanic aquitard range from less than 3×10^{-5} ft/d to greater than 7 ft/d and from 0.0005 to 0.009, respectively. The overall average horizontal hydraulic conductivity was estimated to be less than 0.03 ft/d, indicating that the volcanic units function more as an aquitard than as an aquifer. Based on the presence of bentonitic clays beneath many of the volcanic tuffs, it is inferred that the average vertical conductivity is less than 0.003 ft/d. It has been further concluded that groundwater flow in the volcanic units occurs mainly along fractures and joints. Vertical hydraulic gradients in the volcanic aquitard ranged from 0.07 ft/ft upward to 0.2 ft/ft downward.

2.6.4.2.4 Limestone Aquifer

The limestone aquifer consists of the Paleozoic limestone formations. Its hydraulic properties and subcrop position vary greatly from place to place. At the Apache Tejo well field, this aquifer lies at a depth of 250 feet bgs and exhibits karst characteristics near its top. Data from two wells at the older tailing ponds indicate that the transmissivity of the limestone aquifer is less than 13 ft²/d. Transmissivities in the karstic interval exceed 134,000 ft²/d.

The hydraulic connection between the limestone aquifer and overlying units appears to be limited in the mine area. During a 40-year interval, water levels in the Gila aquifer and underlying volcanic aquitard seem to have been comparatively unaffected by water level changes in the deeper limestone aquifer, implying that no direct hydraulic connection exists in the areas monitored. However, in the vicinity of the

Apache Tejo well field, which produces water from the limestone aquifer, vertical gradients up to 0.4 ft/ft occur in the Gila aquifer, suggesting some leakage from the Gila aquifer into the underlying limestone aquifer.

2.6.5 Soils and Vegetation

2.6.5.1 North Mine Area

The North Mine Area is included in the Santana-Rock outcrop-Lithic Ustorthents Association. This soil association is characterized by well drained, shallow soils on gently sloping to very steep hills and mountains. Soils in this mine area are dominated by volcanic rock outcrop with shallow deposits of clay loam and sandy loam.

The North Mine Area is within the Coniferous and Mixed Woodland Vegetation Type of the Woodland and Savanna Vegetation Zone of New Mexico. The Woodland and Savanna Vegetation Zone is characterized by canopies that are rarely closed and trees that are generally smaller in stature than "forest" tree species.

The vegetation associations generally found in the North Mine Area include the following:

- Sparsely vegetated cliffs - Although not extensive, this association is readily observed south and east of the Santa Rita pit. The slopes of Ben Moore Mountain are typical of this association.
- Oak/juniper woodland - This association is primarily located on middle slopes and below ridge-tops. It includes canyon live oak, gamble oak, and alligator juniper with a grass understory. At the base of cliffs and extending downslope along drainages, relatively dense groves of gamble oak occur, apparently due to higher moisture availability.
- Juniper/pinyon pine/oak savanna - This association is similar to the oak-dominated community noted above, but it generally occurs at higher elevations or on north-facing slopes.

- Riparian mixed deciduous shrub - Riparian communities adapted to episodic flooding occur along ephemeral stream channels. Local areas along Whitewater Creek support an occasional Chinese elm or sugarberry tree. Some areas also support sparse stands of juniper and/or oak intermixed with honey mesquite.

2.6.5.2 South Mine Area

The South Mine Area contains 14 soil map units.

Near Hurley and the tailing ponds, Flack gravelly loam and Lonti gravelly loam and gravelly clay loam are widespread units.

Very cobbly loam and very cobbly clay loam phases occur east of Lake One.

Proceeding along the Whitewater Creek channel from Pond 7 to the San Vicente Arroyo, the major soil map units are a complex of Paymaster fine sandy loam and Ellicott gravelly sand, followed southward by the Manzano-Ruidoso association and Mimbres Arizo-Riverwash association.

South Mine Area vegetation associations are typical of the desert grasslands of New Mexico. The predominant vegetation present on the various terrains at Chino are as follows:

- A community of mixed grasses, yucca, and cactus is present on the gently rolling surfaces of the south and west portion of the South Mine Area.
- Honey mesquite-dominated communities with grasses, yucca, and cactus are present on nearly level to gently sloping terraces and fan remnants along ephemeral drainages.
- Deciduous shrub-dominated associations occur along undisturbed (by mining activity) segments of Whitewater Creek.
- The tailing ponds have some grasses and scattered shrubs growing on Gila Conglomerate used by Chino to cap Ponds 2, B, and C and parts of 4 and 6.

- There are listed endangered flora that may occur in the Chino mine area.

2.6.6 Wildlife

2.6.6.1 Wildlife Habitat

The undisturbed lands that encompass and surround Chino Mine harbor diverse vegetation and wildlife communities. General habitat types include riparian corridors, rock outcrops and cliffs, foothills, canyons, mixed woodlands, grasslands, and disturbed habitats.

2.6.6.2 Mining Operations Impacts to Wildlife and Wildlife Habitat

Information on impacts of mining operations on resident wildlife and their associated habitats is limited. The 1996 and 1997 ecological surveys focused on relatively unimpacted lands bordering the mine. However, some species were documented as using disturbed areas of the mine (i.e., Santa Rita Pit and tailing ponds).

2.6.7 Material Characteristics

Materials characterization programs are ongoing at Chino for several types of materials: stockpile, tailing, and borrow materials. The purpose of these programs is to determine the nature and magnitude of impacts that may potentially result from the interaction between the stockpiled materials (or their derivatives, such as slag or tailing) and the environment. In addition, an evaluation of the nature and availability of suitable cover material is an important part of planning for suitable closure of the mine facilities. Sections 2.6.7.1 through 2.6.7.4 describe the findings to date regarding the various materials at Chino.

2.6.7.1 Stockpile Materials

Compositional models have been developed for the leach and non-leach stockpiles at Chino. This work is based in part on the Chino Resource Model that is used by Chino as a long-term planning tool for predicting, as accurately as possible, ore, leach, and waste rock distribution within the pit prior to it being mined. This model is based on a large amount of drillhole assay, mineralogical, and geologic data. The model assigns codes for a number of categories for evaluating environmental impacts, the most important of which are general geology, mineral

population, and alteration. The pertinent codes for each of these categories are presented in Table 2-1. These codes are used to select samples for the waste rock characterization program.

A large number of rock samples were collected for baseline studies in support of the mine expansion EIS and characterization of the Lampbright stockpile. The samples were selected to represent the compositional range of rock types anticipated to be disposed in a manner that might result in poor-quality seepage (e.g., on stockpiles). Sample characterization has included whole rock chemistry, mineralogy (visual description and x-ray diffraction), static acid-base accounting, and a limited number of kinetic tests.

The results of the geochemical characterization are combined with compositional models for each stockpile. The composition and spatial distribution of specific rock types is based on mine records.

2.6.7.2 Tailing Materials

The older tailing ponds have been constructed by the upstream method from perimeter starter dikes. The tailing ponds show an internal tailing pond stratigraphy that grows progressively finer from embankment dikes to the decant pond. The pond sediments are highly layered and there is a general coarsening-upward stratigraphy near the pond embankments.

The average moisture content of the ponds is highest in the slimes (intervals dominated by finegrained sediments). The interval near the pond base appears to be saturated in the slime areas, nearly saturated in areas containing mostly intermediate-textured sediments, and unsaturated in coarser-grained (sands) locations.

Core data indicate that the tailing is commonly layered on a fine scale (inches to tenths of inches), which greatly reduces vertical hydraulic conductivities relative to horizontal conductivities and enhances lateral flow toward topographic lows. Average laboratory vertical saturated hydraulic conductivities for silty sands and silts to silty clays were 1.2×10^{-4} and 1.1×10^{-7} centimeters per second (cm/s), respectively.

Neutron moisture gauge logging suggests that drainage from the ponds is approaching steady state. Based on a simple flow model, the total seepage flux from all the older tailing ponds to underlying groundwater is estimated to be between 11 and 160 gpm (0.1 to 1.5 inches per year).

The major minerals recognized in the tailing by x-ray diffraction analysis were chlorite and clay minerals, quartz, sericite, magnetite, pyrite, and potassium feldspar.

Laboratory analyses of tailing samples indicate that Acid Generating Potential (AGP) exceeds Acid Neutralizing Potential (ANP). The pore waters in the older tailing ponds generally exceed NMWQCC standards for boron, manganese, sulfate and total dissolved solids (TDS).

2.6.7.3 Borrow Materials

MMD criteria for judging the suitability of soils and soil substitutes in reclamation applications were used for comparative purposes to evaluate the suitability of the soils and soil substitutes at the Chino Mine.

The intent of soil evaluation is to establish the general character and extent of soils and geologic materials that could be used to support closure/closeout activities (e.g., soil covers, berms, and drainage structures) associated with the future reclamation of mine facilities.

Four classes of material were tested: (1) soils and unconsolidated geologic materials, (2) geologic materials from stockpiles, (3) tailing from the surfaces of the tailing ponds, and (4) rock from potential quarry locations. The term "soil" as used in this investigation included earthen materials that are capable of supporting native and adapted vegetation. Thus, native surface soils, semiconsolidated geologic materials, and mining byproducts (leached and unleached geologic materials and tailings) were all considered soil if there are no inherent or insurmountable limitations to plant growth.

The types of materials available for borrow purposes (topdressing or erosion control) include the following:

- Soils formed on the thick alluvial deposits around the tailing ponds (South Mine Area – 220,000,000 cubic yards)

- Topdressing associated with the unmineralized Tertiary volcanics (North Mine Area – 52,000,000 cubic yards)
- Kneeling Nun Tuff (North and South Mine Areas)
- Clast-dominated alluvium (volcanic facies of the Gila Conglomerate) composed of hard, durable basalt (South Mine Area)

2.7 Description of Mining Facilities

This section describes the primary existing mine facilities as shown on Drawing Chino-01, Appendix B. The chief mine components are:

- Santa Rita pit
- Waste Rock and leach stockpiles
- Maintenance facilities
- SX/EW plant
- Ivanhoe Concentrator
- Groundhog Mine
- Tailing impoundments
- Water management system (including reservoirs)
- Ancillary infrastructure

These facilities, as well as the Groundhog Mine area, are discussed in Sections 2.7.1 through 2.7.11.

2.7.1 Santa Rita Pit

The Santa Rita pit has been in existence for more than 85 years. In 1998, the Santa Rita pit was approximately 1,500 feet deep and 1.8 miles in diameter and covered an area of about 1,500 acres. The uppermost level of the pit rim was located on the south side at an elevation of approximately 6,600 feet above mean sea level (msl), and the lowest level in the pit is near the south-center of the pit at an elevation of about 5,100 feet above msl. The pit has been developed in 50-foot benches with side slopes ranging from 2.1 to 2.9 feet horizontal to 1 foot vertical. The

primary crusher is located approximately 3,200 feet west of the pit at an elevation of 6,200 feet above msl.

2.7.2 Waste and Leach Stockpiles

The Chino Mine permit area contains several stockpiles located near the Santa Rita pit (Drawing Chino-11, Appendix B). These stockpiles generally fall into two types: leach stockpiles, which are used to extract copper from low-grade ore, and waste rock and overburden stockpiles, which are used to dispose of excavated materials that have little or no contained copper value.

Three main areas of stockpiles exist at the mine:

- The Lampbright stockpiles, which are located east of the Santa Rita pit and consist of two leach segments, the Main Lampbright and South Lampbright stockpiles, and one waste rock stockpile, the Southwest Lampbright stockpile.
- The Whitewater stockpiles, which consist of two low-grade ore leach stockpiles and a waste rock stockpile located south and west of the Santa Rita pit, referred to as the West stockpile, the South stockpile, and the Upper South stockpile, respectively.
- Four stockpiles located within and along the perimeter of the Santa Rita pit, including the North Pit leach stockpiles and the North, Northwest, and Northeast waste rock stockpiles.

2.7.2.1 Lampbright Stockpile

The total stockpile footprint currently covers approximately 830 acres with a maximum elevation rise of approximately 500 feet above the original ground surface. The tops of the stockpiles are nearly level (i.e., sloping less than 5%) and are laced with a network of leach solution distribution piping.

2.7.2.2 Whitewater Leach Stockpiles

The South and West stockpiles both cover about 600 acres each, while the Upper South stockpile is a "no-leach" stockpile and covers about 210 acres.

The West and South stockpiles are used for stockpiling both waste and leach-grade ore, while the Upper South stockpile is dedicated for overburden.

2.7.2.3 Santa Rita Pit Stockpiles

The North Pit stockpiles consist of low-grade ore stockpiles that have been or are currently being leached with raffinate. The resulting PLS is collected in in-pit collection sumps. The North, Northwest, and Northeast waste rock stockpiles consist of both overburden and waste rock materials.

2.7.3 Maintenance Facilities Area

The maintenance facilities area for mine operations are located east of the Santa Rita pit between the West and South stockpiles at the present head of Santa Rita Creek (Drawing Chino-11, Appendix B). A number of offices and storage facilities are located in this area, including mine operations, the assay laboratory, security, the geology, safety, and mine engineering and planning departments, the vehicle and electrical maintenance shops, the primary crusher, and the conveyor (Figure 2-4).

Three small impoundments located along the southeast side of this area collect surface water. The surface water flows southwest and is incorporated into the Whitewater Leach System.

2.7.4 Solution Extraction-Electrowinning Plant

The SX/EW plant is located to the north of the Lampbright stockpiles. Construction of the plant began in 1987 and operations started in 1988. A map of the SX/EW plant area is provided as Figure 2-5.

The SX/EW plant feed pond has a capacity of 1.4 million gallons and is lined with 80-mil high-density polyethylene (HDPE).

Recirculated barren solution leaving the SX/EW plant is called raffinate and is stored in a 900,000 gallon aboveground stainless steel holding tank. Prior to 1997 the raffinate was stored in a 2.3-million-gallon holding impoundment lined with 80-mil HDPE located immediately south of the tank. This impoundment now serves as a standby containment facility in the event that unexpected or emergency conditions arise at the raffinate storage tank. Any overflow or release from the raffinate tank would flow by gravity into the impoundment.

2.7.5 Ivanhoe Concentrator

Buildings or facilities in the area of the Ivanhoe Concentrator (Figure 2-6) include a coarse ore storage area, grinding operations, a laboratory, concentrate and tailing thickeners, a maintenance shop, a guard house, process water tanks, and a storage yard.

A map of the Ivanhoe Concentrator area is provided as Figure 2-6.

2.7.6 Groundhog Mine

The Groundhog Mine is a historical underground mine located east of San Jose Mountain in the upper reaches of Bayard Canyon (Drawing Chino-11, Appendix B). Facilities and workings associated with the mine occupy the saddle between Bayard Canyon and an unnamed tributary of Whitewater Creek to the northwest and extend southwest down Bayard Canyon and southeast into Lucky Bill Canyon. The mine is currently inactive.

2.7.6.1 History

Lasky (1936) summarizes early history of the Groundhog Mine. The mine consists of three claims: the San Jose claim on the northeast side of the saddle at the head of Bayard Canyon, the Groundhog claim in Bayard Canyon, and the Lucky Bill claim in Lucky Bill Canyon.

All three claims are located along the Groundhog fault.

Mining at the San Jose claim was recorded in the late 1860s along the north end of the Groundhog fault. Until 1928, when the San Jose mine became part of the Groundhog operation, the San Jose produced argenteferous lead carbonate ore and some copper carbonates that contained gold and silver.

The Groundhog and Lucky Bill claims were located to the southwest of the San Jose Claim along the Groundhog fault in 1900. Lead carbonate remained the major ore, although the presence of lead vanadate was noted. In the spring of 1928, a leasing company extended a 400-foot-long drift to the north and encountered a large orebody consisting of lead, zinc, and copper sulfides. This orebody was different from those previously worked both in size and nature.

The leasing company working the property sold controlling interest in the three claims in 1928 to ASARCO. ASARCO continued mining operations at the Groundhog Mine into the 1970s and sold the property to Chino in 1994.

2.7.6.2 Facilities

There were five main shafts at the Groundhog Mine. Four of the shafts are located in Bayard Canyon, including (from north to south) the San Jose, North Groundhog, Groundhog No. 1, and Lucky Bill shafts. The fifth shaft, Lucky Bill No. 5, is located about 1,500 feet southeast in Lucky Bill Canyon (Figure 2-7). Other facilities at the mine included the administrative offices and several other buildings scattered across the site (only the foundations of these buildings remain) and a number of stockpiles located near the shafts along Bayard and Lucky Bill Canyons. As a condition for the property sale in 1994, ASARCO moved the stockpiles from Bayard Canyon to the San Jose shaft area, consolidated them with other stockpiles near the saddle, and covered them with a thin layer of soil. One uncovered stockpile remains at the Lucky Bill No. 5 shaft.

2.7.7 Hurley Power Plant

The Hurley power plant is located on the south side of the smelter complex. This plant was constructed in 1911 to provide a reliable source of power to the Hurley concentrator, which no longer exists. The power plant used coal until 1946, when natural gas became available in the town of Hurley. Currently, the power plant provides a portion of the electrical power for Chino operations. Public utility power provides the remainder of the electrical needs at Chino.

2.7.8 Tailing Impoundments

Tailing generated during the ore concentration process is disposed of in tailing impoundments located at the southern end of the smelter and southward (Drawings Chino-01 and 02, Appendix B). Tailing generated by the former Hurley concentrator was deposited in a series of older tailing ponds (Tailing Ponds 1, 2, B, C, 4, and 6) beginning in 1910. Starting in 1982, tailing from the Ivanhoe Concentrator was disposed of in Tailing Pond 6. Currently, tailing generated by the Ivanhoe Concentrator is pumped through three 9-mile pipelines and deposited in Pond 7, which is the only pond still in normal operation. The tailing impoundments cover about 3,500 acres.

2.7.8.1 Older Tailing Ponds

The older tailing ponds cover a total area of about 1,920 acres. Beginning in 1991, Chino started capping the older tailing impoundments with native soils (Gila Conglomerate) to reduce wind blown particulate matter and as part of final closure of the impoundments.

2.7.8.2 Current Operation

Deposition into Tailing Pond 7 began in mid-1988. Tailing Pond 7 was designed for a 25-year operating life at a 45,000 tons of tailing per day deposition rate. The initial design maximum height of the dam was approximately 230 feet at a crest elevation of 5,475 feet above msl. Tailing Pond 7 covers an area of about 1,635 acres and has a crest length of about 25,500 feet. Tailing Ponds 6E and 6W contain the tailing along the north. The design capacity of Tailing Pond 7 is 415 million tons at an average exterior slope of 4:1.

2.7.9 Water Use and Management

Chino possesses various groundwater and surface water rights that allow the consumptive use of a maximum of 27,489 acre feet per year (afy) of groundwater and 10,900 afy of surface water. Most of this water is used in the mineral processing operations at the Ivanhoe Concentrator and Hurley Smelter. Water consumption at the mine in 1997 was about 18,920 afy (11,720 gpm). This consumption varies with weather conditions and the production rate.

Chino's water management system consists of the following facilities:

- Production wells that supply process water
- Reservoirs for storage of process water, storm water runoff, and some of the ephemeral flows in the major drainages
- Miscellaneous tanks and sumps that collect and store process solutions
- Diversion structures for rerouting natural drainage channels around operational facilities.
- Pipelines and pumping stations for transferring water from one location to another

Water conservation is practiced through the recirculation of process water and treatment and reuse of municipal wastewater from nearby towns. Figure 2-9 shows the water supply and use cycle at the mine.

Several well fields that may be loosely grouped based upon location supply most of the water used by the mine. These well fields include several individual production and dewatering wells and interceptor well systems in the Santa Rita pit area, two well fields and an interceptor well system near the tailing ponds, and several well fields located several miles south of the tailing ponds. Groundwater is also pumped from underground workings in the Santa Rita pit area.

Several reservoirs that serve as impoundments for PLS, other process solutions, and storm water runoff are located throughout the mine site. The major reservoirs are shown on Drawing Chino-11, Appendix B. Most of the reservoirs are located in the vicinity of the Santa Rita pit and associated stockpiles. Table 2-2 provides details regarding the various reservoirs and storage tanks in operation at the mine.

Major diversion channels that are part of the Chino Mine storm water and stream flow management system include:

- The North Diversion Channel, that is part of the storm water control system that routes runoff around the Lampbright stockpiles to Lampbright Draw.
- The Whitewater Creek diversions in the south mine area, including the 1911 diversion around the older tailing pond area, the 1984 diversion around Lake One, and the 1988 and 1998 diversions around Tailing Pond 7.

2.7.10 Other Ancillary Facilities, Structures, and Systems

In addition to the major project facilities, structures, and processes identified above, there are a number of ancillary (supporting) facilities at the Chino site:

- Administrative/office facilities
- Outdoor lighting
- Haul and access roads
- Electrical power transmission lines
- Explosive, fuel, and reagent storage areas

- Drainage, diversion, and sediment control structures
- Fencing and security systems
- Miscellaneous pipelines

2.8 Permits and Discharge Plans

2.8.1 Existing Permits

Chino currently conducts its mining operations pursuant to numerous state and federal regulations covering groundwater, surface water, air, solid and hazardous wastes. Table 2-3 lists permits held by Chino for current mining activities. Information regarding those permits is summarized as follows:

2.8.1.1 Mine Operation Permit

To meet requirements of the NMMA, Chino obtained approval of its existing mining operation permit from the MMD in December 1997.

2.8.1.2 National Pollutant Discharge Elimination System (NPDES) Permit

Chino received an NPDES permit from the U.S. Environmental Protection Agency (EPA) on August 6, 1985 a renewal for 5 years on October 15, 1993 and a renewal for 5 years on February 25, 2000. The permit provides for two outfalls: Outfall 001, immediately west of the former precipitation plant on Whitewater Creek, and Outfall 002 at the spillway of Reservoir 8 on Lampbright Draw (Drawing Chino-11, Appendix B). These sites are permitted as zero-discharge outfalls, except in cases of extreme precipitation events, when excess storm water may be discharged if it satisfies certain water quality standards.

2.8.1.3 NPDES Multi-Sector Storm Water General Permit

NPDES storm water general permits cover the Chino mine, smelter, and associated facilities. To meet additional requirements, Chino has prepared a Storm Water Pollution Prevention Plan and an Emergency Response Plan. Chino has filed an application for coverage under the multi-sector general storm water permit.

2.8.1.4 Water Rights

Groundwater and surface water rights held by Chino are recorded at the New Mexico Office of the State Engineer (OSE) and allow consumptive use of 27,489 acre-feet of groundwater and 10,900 acre-feet of surface water per year. Also registered with the OSE are 16 reservoirs and at least 108 production wells.

2.8.1.5 Air Quality

The New Mexico Air Quality Control regulations, and Clean Air Act Title V permit program apply to the Smelter.

Air Quality Permit 298-M-3 from NMED regulates the Concentrator circuit and was last modified April 28, 1994 to allow an increase in the average amount of ore processed from 50,000 to 60,000 tons per day. This permit contains particulate emissions and limits and mandates emission control devices and records of daily and annual production.

Air Quality Permitting from NMED regulates the SX/EW to allow emissions of VOCs.

Permit renewal is not required unless changes are made in the systems that increase contaminant emissions.

2.8.1.6 Other Permits

Chino possesses a Radioactive Materials License from the NMED for storage and use of density gages and x-ray analyzers, and an explosives permit from the federal Bureau of Alcohol, Tobacco and Firearms for blasting in the Santa Rita pit.

2.8.1.7 Plans of Operation

Federal BLM Regulations in 43 CFR Subpart 3809 require an approved plan of operations for activities conducted on public lands that disturb 5 or more acres. To comply with these regulations, Chino submitted plans of operations in 1981, 1995, and 1997 and an Environmental Assessment (EA) in 1996.

2.8.1.8 Administrative Order on Consent

An Administrative Order on Consent (AOC) between the NMED and Chino became effective December 23, 1994. The AOC is a voluntary, yet binding, agreement between Chino and the NMED designed to identify and remediate effects to the environment.

that are not addressed under other regulatory frameworks. The AOC is aimed at evaluating potential historical effects of Chino's mining operations and is designed to be generally consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The AOC identifies six investigation units (IU's) within the investigation area: the Hanover Creek, Hurley Soils, Lampbright, Smelter, Tailing Area Soils, and Whitewater Creek IU's. After the AOC was finalized, one additional study was added to address media on a site-wide rather than an individual geographical unit basis. This IU is the Ecological IU, designed to characterize site-wide ecological issues. Investigations began in 1995 and are expected to be completed in 2004.

2.8.1.9 Groundwater Discharge Plans

NMWQCC regulations require a DP for any discharge of effluent or leachate that has the potential to move directly or indirectly into groundwater. The Chino Mine operates pursuant to eight DP's, that are listed in Table 2-4.

On March 25, 1998, all Chino DP's were amended by the NMED to incorporate the Comprehensive Groundwater Characterization Study (CGCS). The CGCS is a site-wide investigation designed to provide a comprehensive evaluation of existing groundwater data and to identify and fill any data gaps. The CGCS will be used to determine the appropriate regulatory program (DP, AOC, or NMMA) to address further investigation of groundwater contamination and remediation for both historical and operational sources.

2.8.2 Discharge Plans (DPs)

The DPs in the North Mine Area and the primary facilities they govern include:

- DP-376: Lampbright stockpiles and Reservoir 8
- DP-591: SX/EW plant and Reservoirs 6 and 7
- DP-459: North Pit leach stockpiles, North, Northwest, and Northeast Waste Rock Stockpiles Reservoir 5, and Santa Rita pit
- DP-493: Reservoir 3A

- DP-526: Whitewater stockpiles, Reservoirs 2 and 4A, and Whitewater Creek between the Ivanhoe Concentrator and Lake One
- DP-213: Ivanhoe Concentrator and associated pipelines

The DPs in the South Mine Area and the primary facilities they govern include:

- DP-214: The Hurley Smelter, Lake One, Axiflo Lake, the older tailing ponds, and Whitewater Creek from Lake One to its confluence with San Vicente Arroyo
- DP-484: Tailing Pond 7 and the 1988 Whitewater Creek diversion channel

2.8.2.1 DP-376, Lampbright Stockpiles and Reservoir 8

The primary facilities to be closed in the DP-376 area are the Lampbright stockpiles, which are located east of the Santa Rita open pit and southeast of the SX/EW plant, and Reservoir 8, located at the southern foot of the South stockpile in Tributary 1. These facilities, associated ancillary facilities and features, and other pertinent data are shown on Drawings Chino-01, 11, 12, 13 and 26, Appendix B.

The Lampbright stockpiles currently consist of the Main, South, and Southwest Lampbright stockpiles. The Main and South Lampbright stockpiles cover approximately 830 acres and are located adjacent to one another, mostly within a tributary valley (Tributary 1) of Lampbright Draw. The Main Lampbright stockpile is located primarily within the drainage area of Tributary 1, and is bounded on the north by the North Diversion Channel and on the east by Tributaries 2 and 2A. The South Lampbright stockpile is a southward extension of the Main Lampbright stockpile. These stockpiles are currently built in 30-foot lifts and used for leaching low-grade copper ore. The Southwest Lampbright stockpile is located on the northeast-facing slope of Ben Moore Mountain and is currently built in 50-foot lifts of waste rock.

PLS from the Lampbright stockpiles is collected in Reservoir 8, from which it is then pumped to the SX/EW plant for copper recovery. Reservoir 8 also receives storm runoff from the outslopes of the stockpiles. Six detention ponds intercept storm runoff from Tributary 1, including that from the Southwest

Lampbright Stockpile, and provide increased runoff storage capacity and lower peak flows into Reservoir 8

Three sumps (Lampbright sumps 1, 2, and 3) are located along the north side of the Main Lampbright stockpile. These sumps collect some seepage and storm water runoff, both of which are then pumped back to the feed pond at the SX/EW plant. One additional sump (the East Lampbright sump) is located on the central eastside of the Main Lampbright stockpile. Fluids collected at this sump are diverted in a channel to lower sections of the South Lampbright stockpile, adding to the PLS flow.

2.8.2.2 DP-591, SX/EW Plant and Reservoirs 6 and 7

The primary facilities to be closed in the DP-591 area are the SX/EW plant, the PLS feed pond, the raffinate storage tank and overflow pond, Reservoirs 6 and 7 and associated conveyance systems, and an interceptor well. The area covered by DP-591 is shown on Drawings Chino-01, 11, 12 and 26, Appendix B.

The capacities of Reservoirs 6 and 7 are approximately 93 million gallons and approximately 82 million gallons, respectively. Both reservoirs are used for storage of storm water and process water overflow during storm events. Both reservoirs receive overflow from Reservoirs 4A and 2. Reservoir 7 receives excess storm water and PLS from Reservoir 8.

2.8.2.3 DP-459, North Pit Stockpiles, Reservoir 5, and Santa Rita Pit

The primary facilities to be closed in the DP-459 area are four stockpiles (the North Pit leach and the Northeast, Northwest, and North waste rock stockpiles), Reservoir 5, and the Santa Rita open pit areas (Drawings Chino-01, 11, 12, 13, and 26, Appendix B).

The North Pit leach stockpile is a low-grade ore leach stockpile that extends south into the East Pit area

The Northwest, the Northeast, and the North stockpiles are waste rock stockpiles.

Reservoir 5 is located north of the North stockpile and collects runoff from the mine and Santa Rita Creek.

The Santa Rita pit includes the Lee Hill, Estrella, and East Pit areas as well as a number of PLS, booster, and pit dewatering

collection sumps joined by a network of pipelines to the water management system at the mine.

2.8.2.4 DP-493, Reservoir 3A

The primary facility to be closed in the DP-493 area is Reservoir 3A, an unlined reservoir with a capacity of 1.2 billion gallons located in the former headwaters of Whitewater Creek, south of the South stockpile and the Santa Rita pit (Drawings Chino-01, 11, and 26, Appendix B). As part of the water management system at Chino, Reservoir 3A is connected through pipelines to facilities covered under a number of other discharge plans, including DP-526 and DP-591.

Reservoir 3A is an integral part of the water supply and management system for operations at the mine. During normal operations, Reservoir 3A supplies water to Reservoir 7 for operations at the SX/EW plant and to the raffinate booster station (6525) on the northwest end of the South stockpile. The reservoir also serves as a storage facility for the following sources:

- Storm runoff that naturally flows from the former headwaters of Whitewater Creek
- Water from the Whitewater Leach System, including storm runoff flowing and groundwater seeping into the Whitewater catchments and reservoirs along the periphery of the West stockpile
- Process water from tailing operations (covered under DP-213)
- Makeup water from the Star Shaft
- Water pumped back from Reservoir 7

During emergency conditions, PLS from the Whitewater PLS tank may also be pumped into Reservoir 3A.

2.8.2.5 DP-526, Whitewater Stockpiles and Facilities

The DP-526 area includes a large part of the Chino Mine that lies west and southwest of the Santa Rita pit.

The primary facilities to be closed in the DP-526 area (Drawings Chino-11 and 26, Appendix B) include:

- The Whitewater stockpiles (consisting of the West, South, and Upper South stockpiles)
- Process water reservoirs, including Reservoirs 2 and 4A)
- Storm water and seepage control reservoirs, including Reservoirs 10 and 17
- Process and runoff water pipelines
- The former precipitation plant area
- Ore processing facilities
- The Santa Rita Class D landfill

The West and South stockpiles are used for stockpiling both waste and leach-grade ore, while the Upper South stockpile is dedicated for overburden material.

A number of storm water and process water collection systems are associated with the Whitewater stockpiles:

- Systems at the South stockpile consists of several reservoirs, including Reservoirs 4A and 2 (also referred to as Upper and Lower, respectively), Last Chance Reservoir, and storm water reservoir (Dam 17).
- At the West stockpile, a series of eleven runoff and seepage containment dams and sumps have been installed along the base of the stockpile on its western side to prevent surface and shallow subsurface flow to Hanover Creek. These facilities extend in an arc from the northwest corner of the West stockpile, at Inlet 12, to the southwest above Hanover Creek, and then to the area just west of the Ivanhoe Concentrator, at Dam 15.
- PLS from the West and South stockpiles is collected in ditches or by a flume near the Ivanhoe Concentrator and is pumped to DP-591.

- Storm water runoff from the Upper South stockpile flows to the Santa Rita pit.

The Santa Rita landfill is located on top of the West stockpile on the southwest corner.

DP-526 includes a segment of Whitewater Creek that extends from the precipitation plant to the north end of Lake One by the Hurley Smelter. Dams 16 (and associated pump back system) and 17 are located in this extension, which includes the active channel of the creek for the purposes of evaluating groundwater.

2.8.2.6 DP-213, Ivanhoe Concentrator and Tailing Pipelines

The area covered by DP-213 is shown on Drawings Chino-01, 02, and 26, Appendix B.

The facilities to be closed in the DP-213 area are the Ivanhoe Concentrator and associated pipelines (copper concentrate pipeline, (2) tailing pipelines, nitrogen pipeline, clarified water pipeline).

2.8.2.7 DP-214, Lower Whitewater Creek and Older Tailing Ponds

The DP-214 area is located in the south mine area and shown on Drawings Chino-01, 02, and 26, Appendix B. The area includes the Hurley Smelter, older tailing ponds, Lake One, Axiflo Lake, and a segment of Whitewater Creek extending from the north end of Lake One to its confluence with San Vicente Arroyo approximately 12 miles south of Hurley.

Facilities to be closed in the DP-214 area are the Hurley Smelter, older tailing ponds, Lake One, Axiflo Lake, and several ancillary facilities located at both the smelter area and the older tailing ponds.

Ancillary facilities near the smelter include the Hurley power plant, filter plant, blending plant, thickener, metals recovery unit, oxygen plant, acid plant, revert crusher, slag stockpile, and storage structures for catalyst, matte, revert, precipitate, and flux.

The older tailing ponds (Tailing Ponds 1, 2, B, C, 4, 6E and 6W) cover a total of about 1,920 acres. Ancillary facilities associated with the older tailing ponds include a Class D solid waste landfill, the Tailing Pond 1 landfarm, and pipelines transporting

tailing and tailing pond reclaim water. The Class D landfill is operated under the authority of New Mexico solid waste management regulations. The Tailing Pond 1 landfarm is less than an acre in size and is located at the southern edge of the pond. The landfarm treats non-hazardous hydrocarbon-contaminated soils generated at Chino Mine, the Hidalgo smelter, and the Tyrone and Cobre Mines.

Lake One was created in 1910 by damming Whitewater Creek southeast of the Hurley Smelter. At times water and sediment from Lake One flowed into the mouth of James Canyon. In about 1984 Whitewater Creek was diverted eastward around Lake One, and the lake was eventually drained. The lake is now essentially dry except for incident precipitation, local runoff, and seepage from upstream. Lake One covers about 220 acres and the affected portion of James Canyon covers about 15 acres.

Axiflo Lake is a reservoir constructed just south of Tailing Pond 2 in 1919. Axiflo Lake is currently used for the storage of tailing pond reclaim water from Tailing Pond 7 and fresh makeup water from the Bolton production wells that replaces water lost to evaporation and infiltration. Water stored in Axiflo Lake is pumped to a 230-foot-diameter process-water clarifier at Hurley for treatment along with water supplied by other Chino Mine production well fields. From there it is pumped to the Ivanhoe Concentrator for use in ore processing. Axiflo Lake covers about 90 acres.

The segment of Whitewater Creek covered by DP-214 extends from Hurley to its confluence with San Vicente Arroyo approximately 12 miles to the south. Sometime prior to 1956, Whitewater Creek was diverted from its original channel to allow for construction of Tailing Ponds 6E and 6W. An additional diversion was constructed around the site of Tailing Pond 7 in 1988.

2.8.2.8 DP-484, Tailing Pond 7

The DP-484 area is located at the southern extent of the mine area as shown on Drawings Chino-01, 02, and 26, Appendix B. The DP-484 area includes Tailing Pond 7, an interceptor well system on the south side of Tailing Pond 7, a segment of the 1988 Whitewater Creek diversion channel, and the tailing termination tower end pipeline system.

The facilities to be closed in DP-284 include Tailing Pond 7 (and ultimately the interceptor well field) and auxiliary structures and equipment such as the pipelines and the crane-mounted cyclones.

Tailing Pond 7 covers about 1,635 acres.

The interceptor well system lies along the southern edge of Tailing Pond 7. This system consists of 12 wells that collect impacted groundwater and decant water that seeps from Tailing Pond 7.

In 1988, under the authority of DP-214, Whitewater Creek was diverted from its original channel to allow for the construction of Tailing Pond 7. This diversion channel is located along the eastern perimeter of Tailing Pond 7. In 1998, again under the authority of DP-214, Whitewater Creek was relocated further eastward away from Tailing Pond 7. This later diversion was constructed to prevent seepage from Tailing Pond 7 from entering Whitewater Creek. The 1988 diversion channel remains in place and is used to collect potential surface seeps from Tailing pond 7. It also provides protection to Tailing Pond 7 from large storm water runoff events.

Table 2-1. Chino Resource Model Geological Code Descriptions

Code	Name	Description
General Geology		
3	Upper Paleozoic limestones	Limestones and shaly limestones of the Abo, Syrena, and Oswaldo Formations; good skarn hosts
5	Cretaceous sedimentary rocks	Sandstones, siltstones, and shales of the Beartooth and Colorado Formations; minor limy units
6/7	Cretaceous sills/granodiorite	Early and late sills, including disconformable rocks of similar composition (includes rhyolite sill/all phases of the stock, including granodiorite and Turnerville dikes)
8	Post-mineralization intrusives	Quartz monzonite, quartz latite, and latite dikes and the Whim Hill Breccia
9	Lover's Lane breccia	Lover's Lane breccia
11	Mid-Tertiary volcanic rocks	Sugarlump Tuff and Kneeling Nun Rhyolite and associated mid-Tertiary rocks
Mineral Population		
1	Leached capping	Iron oxides with residual copper sulfides and/or oxides
2	Soluble Cu oxides	Predominantly chrysocolla, minor malachite; Fe oxides common; minor Cu sulfides
4	Native Cu/cuprite	Cu and cuprite predominant Cu minerals; chalcocite or chrysocolla common in minor phases
7	Supergene sulfide enrichment	Predominantly chalcocite with minor covellite; chalcopyrite-bornite mineralization is of little importance
9	Hypogene sulfide mineralization (non-skarn)	Chalcopyrite, minor bornite; trace chalcocite-covellite common, but of minor importance
10	Skarn	Similar to code 9
11	Non-mineralized	Post-mineralization ash-flow tuff
Alteration		
1/2	Quartz-sericite-pyrite (QSP) alteration	Late-stage, high-temperature hydrothermal alteration
3	Argillic alteration	Advanced, low-temperature hydrothermal alteration; clay minerals
9	Unaltered	Minerals not transformed
10/11	Potassic alteration	Less advanced, low-temperature hydrothermal alteration; K-feldspar, biotite
20	Prograde alteration (skarn)	Garnet, diopside, magnetite
21	Retrograde alteration (skarn)	Actinolite, epidote, pyrite, clinopyroxene

Table 2-2. Reservoirs
Page 1 of 3

Reservoir	Discharge Plan	Dam Type	Location ^a	Reservoir Size (acre-feet)	Water Source	Discharges to
2	526	Concrete	SSA: Between 4A and Last Chance in Whitewater Creek Basin	3.5	PLS from stockpiles and Reservoir 4A, storm runoff from precipitation plant and concentrator, and overflow from Reservoir 4A, OHP, and PLS tank. Receives discharge from Last Chance, Dam 16 and Reservoir 17.	Water can be pumped to Reservoir 4A or OHP. Overflows into Last Chance.
3A	493	Clay core	SSA: South perimeter of South stockpile	3,680	Process water from former precipitation plant, storm water from Reservoir 2 and 7.	Dispersed on top of south stockpile, Reservoir 7.
4A	526	Large concrete and earthen	SSA: Adjacent to South stockpile and upgradient of Reservoir 2	46	PLS from stockpiles and PLS collection pond, storm runoff from precipitation plant and mine shop area, and overflow from PLS pond, PLS tank, and OHP. Receives discharges from Last Chance, Reservoir 2 and 17.	Water can be pumped to Reservoirs 6 and/or 7 via two 16-inch pipes and to the OHP.
5	459	NA	North of Northeast stockpile	233	Storm runoff from Upper Santa Rita Creek and process water storage.	Make-up water source, North Diversion Channel as necessary.
6	491	NA	SSA: Northwest of SX/EW plant	285	Process water overflow, storm runoff.	Pumped to Reservoir 7.
7	491	NA	SSA: Southwest of SX/EW plant	252	Reservoir 3A, storm runoff, and overflow from Reservoir 8.	Water is pumped to Reservoirs 3A, 6 and the SX/EW plant.
8	376	NA	SSA:	39	PLS collection.	SX/EW plant.
9	None	NA	SSA: Near south rim of Santa Rita pit	47	Storm runoff.	Make-up water source, as necessary.
10	526	Large concrete	WSA: Northernmost large dam	2.58	Stockpile runoff and seepage.	Water is pumped via 12-inch pipe to above Reservoir 4A.
11	526	Large concrete	WSA: Southernmost large dam	2.8	Stockpile runoff and seepage.	Water is pumped via 12-inch pipe to above Reservoir 4A.
12	526	Small concrete and earthen	WSA: Northernmost structure	±0.03 ^b	Stockpile runoff and seepage.	Gravity discharges via a 22-inch pipe to Reservoir 10.

^aSSA = South stockpile area
WSA = West stockpile area
^bCollection basin

PLS = Pregnant leach solution
OHP = Old high head pumps

NA = Information not available
SX/EW = Solution extraction/electrowinning

TDRW = Tailing decant return water

Table 2-2. Reservoirs

Page 2 of 3

Reservoir	Discharge Plan	Dam Type	Location ^a	Reservoir Size (acre-feet)	Water Source	Discharges to
13	526	Medium earthen	WSA: 300 feet north of Dam 14, near middle of West stockpile	1.0	Stockpile runoff and seepage	Water is pumped to above Reservoir 4A and connects via pipe to Reservoir 14
14	526	Large concrete	WSA: 1,000 feet north of Dam 11	4.7	Stockpile runoff and seepage	Water is pumped to above Reservoir 4A and connects via pipe to Reservoir 13
14-1	526	Small earthen	WSA: 700 feet north of Dam 13	±0.03 ^b	Stockpile runoff and seepage	Gravity discharges via pipe to Reservoirs 13 and 14
14-2	526	Small earthen	WSA: 500 feet north of Dam 13	±0.03 ^b	Stockpile runoff and seepage	Gravity discharges via pipe to Reservoirs 13 and 14
15	526	Small concrete	WSA: South of mine entrance road, 500 feet west of lay down yard by concentrator	±0.03	Stockpile runoff and seepage	Concentrator thickeners
16	526	Coffer dam	SSA: 2,200 feet down Whitewater Creek from Last Chance	NA	Alluvial flow from Whitewater Creek	Reservoir 2
17	526	Large concrete	SSA: Directly downgradient of Last Chance	46.8	Emergency stormwater collection	Water can be pumped to Reservoirs 4A, OHP, PLS tank or 380 thickener
18	526	Small concrete and earthen	WSA: 300 feet west of Dam 11	±0.5	Seepage from Reservoir 11	Water is pumped by small sump pump to Reservoir 11
19	526	Small earthen	WSA: 200 feet west of Dam 13	±0.5	Seepage from Reservoir 13	Water is pumped by small sump pump to Reservoir 13

^aSSA = South stockpile area

WSA = West stockpile area

^bCollection basin

PLS = Pregnant leach solution

OHP = Old high head pumps

NA = Information not available

SX/EW = Solution extraction/electrowinning

TDRW = Tailing decant return water

Table 2-2. Reservoirs

Page 3 of 3

Reservoir	Discharge Plan	Dam Type	Location ^a	Reservoir Size (acre-feet)	Water Source	Discharges to
20	526	Small earthen	WSA: Adjacent to north side of mine entrance road by abandoned guard shack near concentrator	±0.03	Storm runoff	Water is pumped by small sump pump to above Reservoir 4A
6525 Tank	526	Stainless steel	SSA: Northwest end of South stockpile	0.3	Water from SX/EW raffinate tanks or SX/EW PLS tank	Water is dispersed on top of South stockpile
Axiflo Lake	214	Earthen	South of tailing pond 2	NA	TDRW, Tailing Pond 7 interceptor system, Bolton well field	230 Tank
Lake One	214	Earthen	Southeast of Hurley Smelter	NA	Use discontinued in 1981	NA
PLS pond and launder	526	Small concrete	SSA: Adjacent to South stockpile and upgradient of Reservoir 4A	NA	PLS collection from South and West stockpiles; storm runoff from stockpiles and mine shop area	Water gravity drains to PLS tank, OHP, or Reservoir 4A
PLS tank	526	Concrete and stainless steel	SSA: Between Reservoir 4A and Reservoir 2	1.53	PLS from PLS pond, overflow from OHP	PLS is pumped to SX/EW plant, overflows to Reservoir 4A or OHP
South side booster	526	Earthen sump	SSA: Southwest end of South stockpile	±0.3	Water from OHP or Reservoir 3A	Water is pumped to Reservoir 3A or dispersed on top of South stockpile

^aSSA = South stockpile area
WSA = West stockpile area

^bCollection basin

PLS = Pregnant leach solution
OHP = Old high head pumps

NA = Information not available
SX/EW = Solution extraction/electrowinning

TDRW = Tailing decant return water

Table 2-3. Summary of Chino Closure/Closeout-Related Permits

Permit or Requirement	Agency	ID Number	Area Covered
Registration	U.S. Department of Labor, Mine Safety and Health Administration	29-01882	Ivanhoe concentrator
	New Mexico Mining Minerals Division	29-00762	SX/EW plant
		29-00708	Santa Rita pit, limestone quarry, gravel pit
Groundwater Discharge Plan	NMED Ground Water Quality Bureau	See Table 2-1b	See Table 2-1b
National Pollutant Discharge Elimination System (NPDES)	U.S. EPA (Region 6)	NM0020435	Two outfalls, one in Whitewater Creek and one in Lampbright Draw
NPDES Stormwater General Permit	U.S. EPA (Region 6)	NMR00A101 NMR00A106 NMR00A107	Limestone quarry Concentrator Hurley smelter
Water Rights	New Mexico State Engineer Office	NA	NA
Air Quality	NMED Air Quality Bureau	298-M-3	Concentrating circuit
SARA Title III			
Hazardous Waste Generator/	U.S. EPA/New Mexico Department of Public Safety State and County Emergency Response Commission	NMD360010029	Smelter
Hazardous Materials Inventory		NMD007396930	Mine
Hazardous Materials Transporter	U.S. Department of Transportation	052793-49-302B	NA
Individual Liquid Waste Permit	NMED, Construction Industries Division	SC930019 SC930020 SC930021	Hurley area Hurley area Tailing area
Plan of Operation	Bureau of Land Management	Submitted in 1981 and 1997	All federal land

Source: Chino, 1997a

SX/EW = Solution extraction/electrowinning
NMED = New Mexico Environment Department

U.S. EPA = United States Environmental Protection Agency
NA = Not applicable

Table 2-4. Summary of Chino Closure/Closeout-Related Discharge Plan Areas

Discharge Plan	Area Description	Permitted Effluent		Area Permitted (acres)
		Type	Volume (gpd)	
213	Ivanhoe Concentrator and tailing pipelines	Tailing slurry Copper concentrate Domestic wastewater	24.5 million 237,600 3,200	110
214	Older tailing ponds, Lake One, Axiflo Lake, and Hurley Smelter	Emergency flow to Ponds 4, 6E and 6W Decanted flows from Pond 7 Makeup water from interceptor wells to Axiflo Lake From Axiflo to 230-ft-dia tank clarifier	8.7 million 5 million 13.4 million	2,390
376	Lampbright leach system	PLS	26.5 million	905
459	North Pit leach system	All discharges (PLS, seepage)	6.48 million	1,780
484	Tailing Pond 7	Tailing slurry from concentrator Sewage effluent from Tri-City Sewage effluent from North Hurley Treated mine water during heavy precip.	24.5 million 1 million 9,900 1.4 million	1,410 max.
493	Reservoir 3A	Mine water and stormwater	10.0 million	50
526	Whitewater Leach System, Reservoir 17, and Whitewater Creek from the Ivanhoe Concentrator to Lake One	Acidic leach solution	24.5 million	1,445
591	SX/EW plant, Reservoirs 6 & 7	Acidic leach solution	23.0 million	100

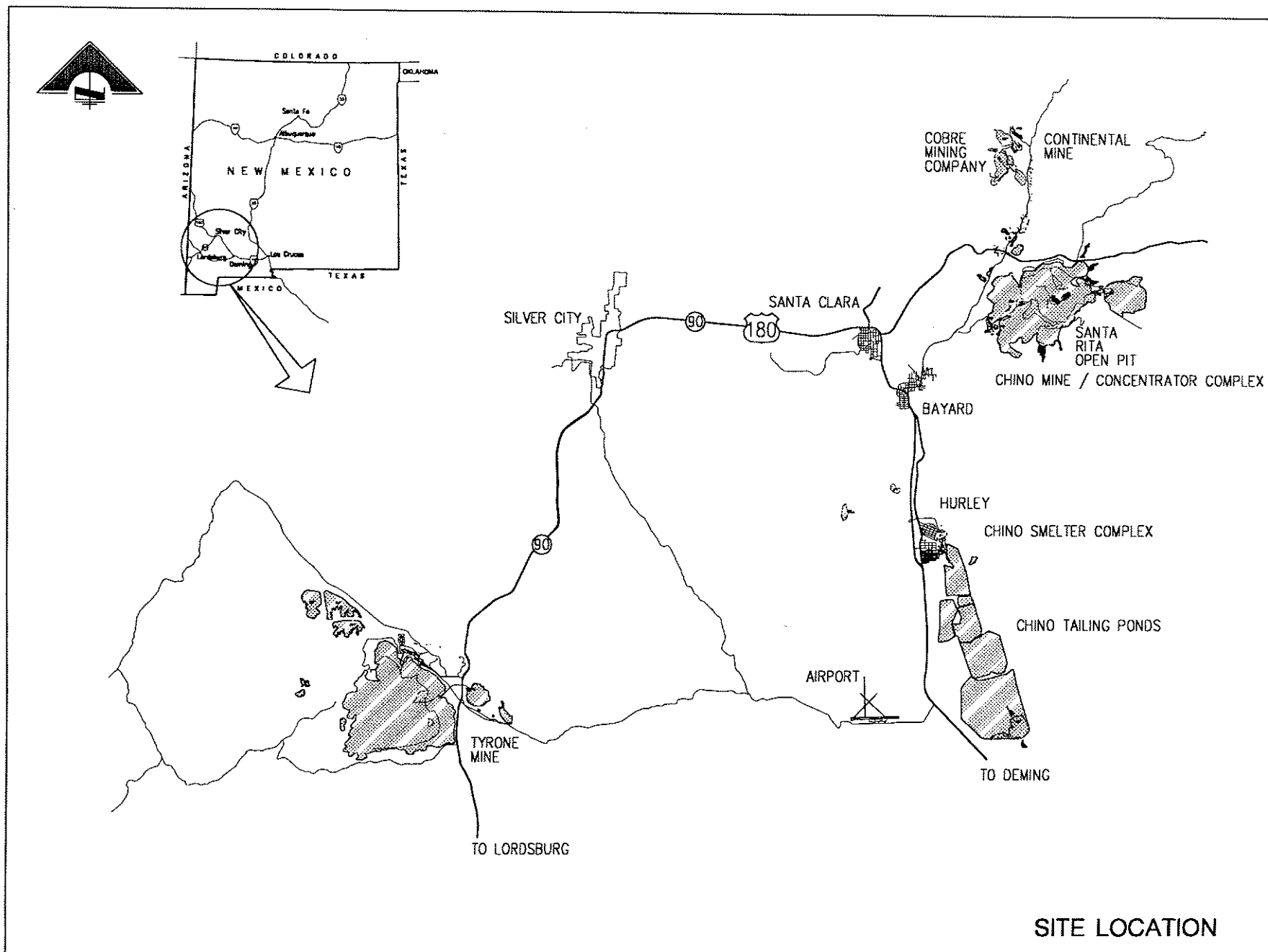
Sources: Chino, May 1997; Discharge Plan documents

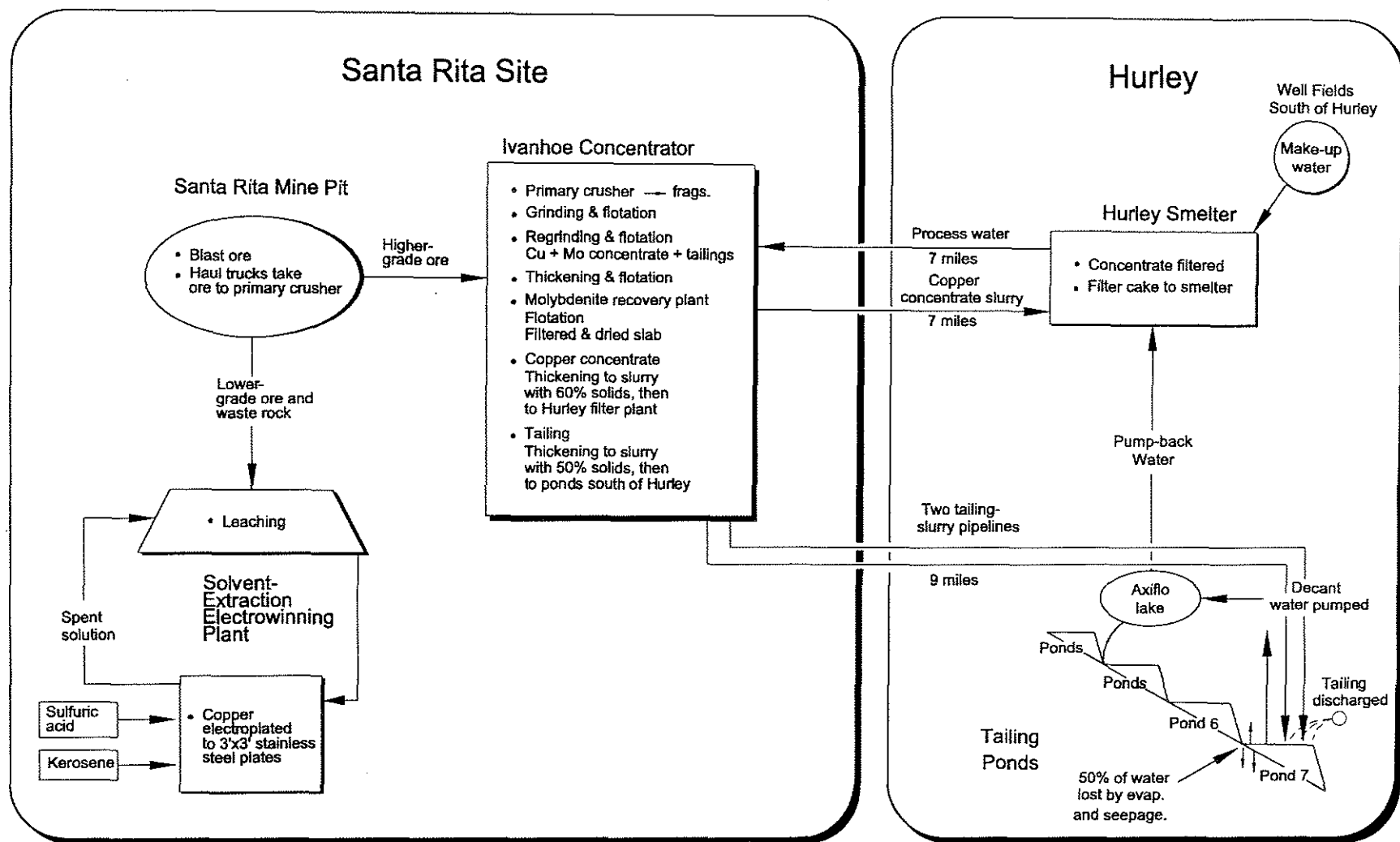
Gpd = Gallons per day

SX/EW = Solution extraction/electrowinning

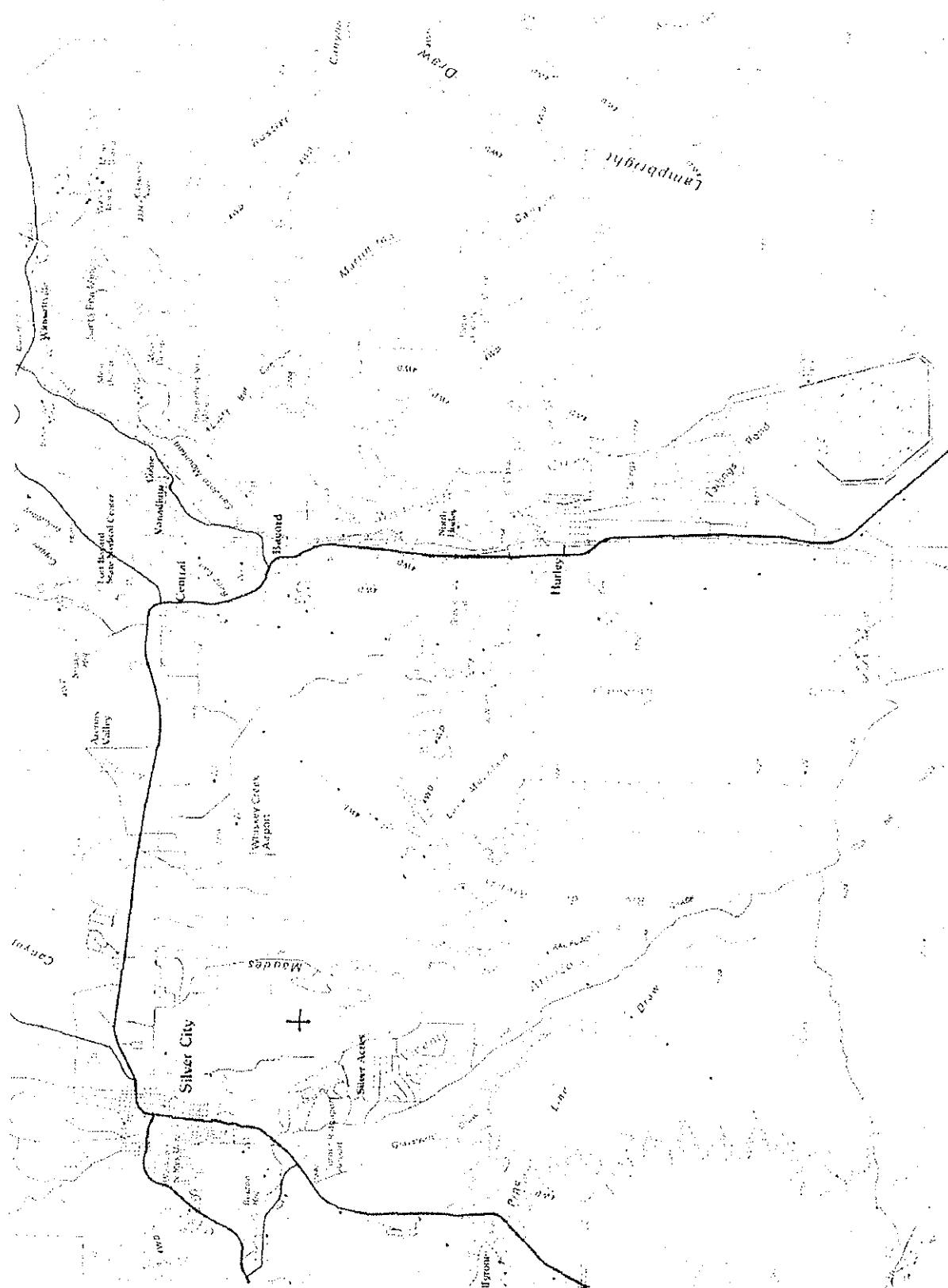
PLS = Pregnant leach solution

Figure 2-1





CHINO CLOSURE/CLOSEOUT
Ore-Processing Operations at Santa Rita
and Hurley Sites of Chino Mine



Topography
Figure 2-3

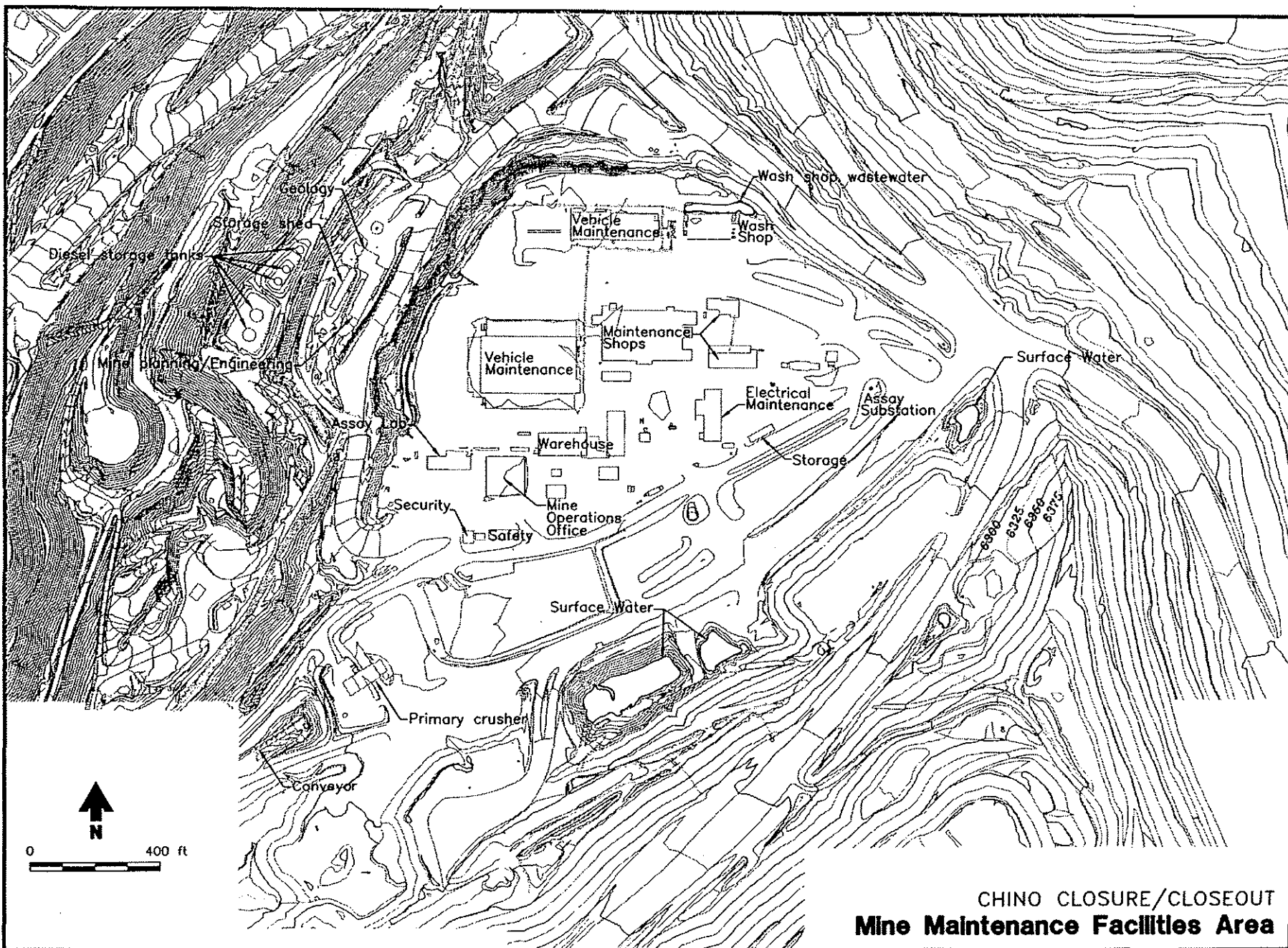
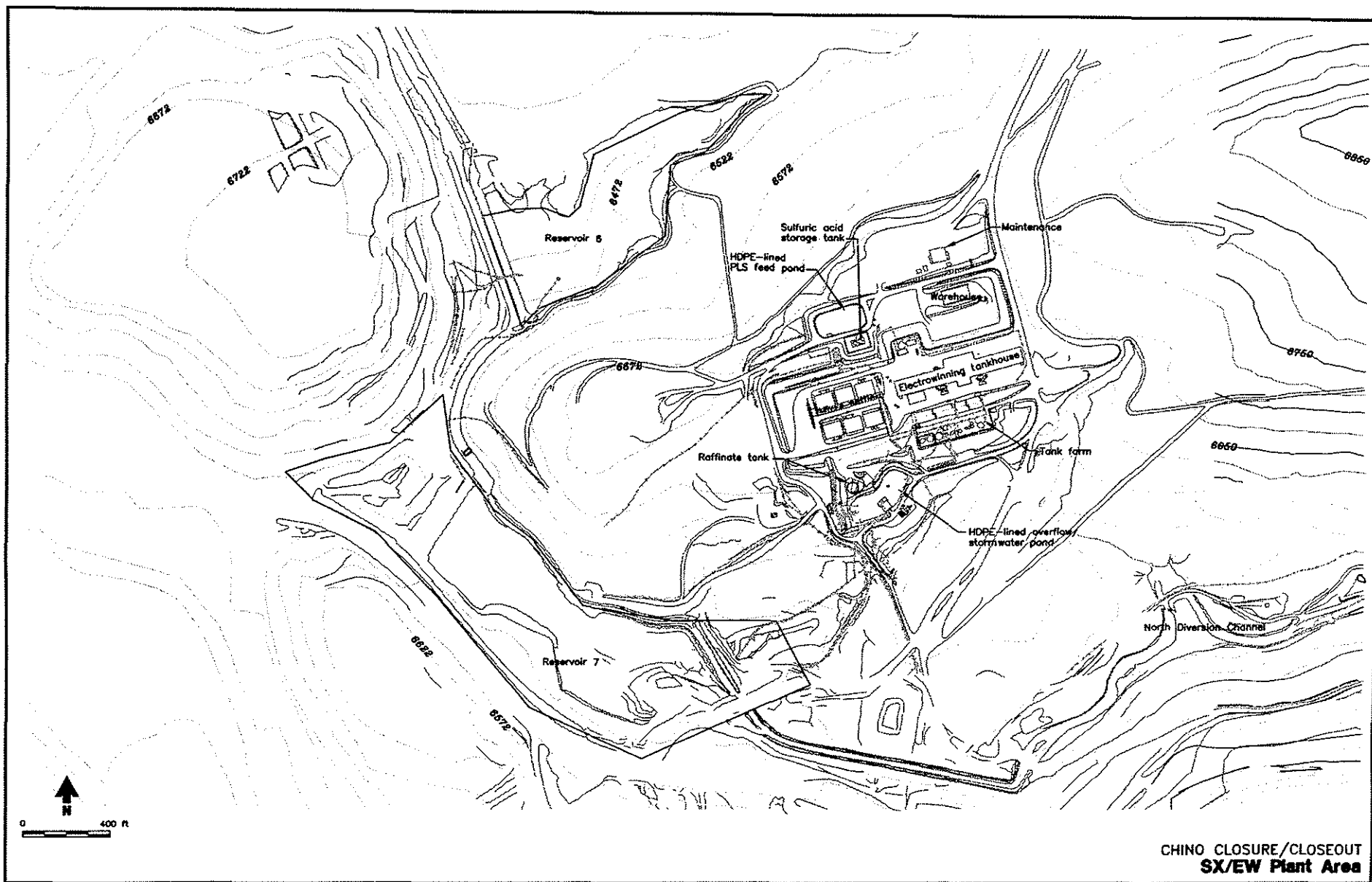
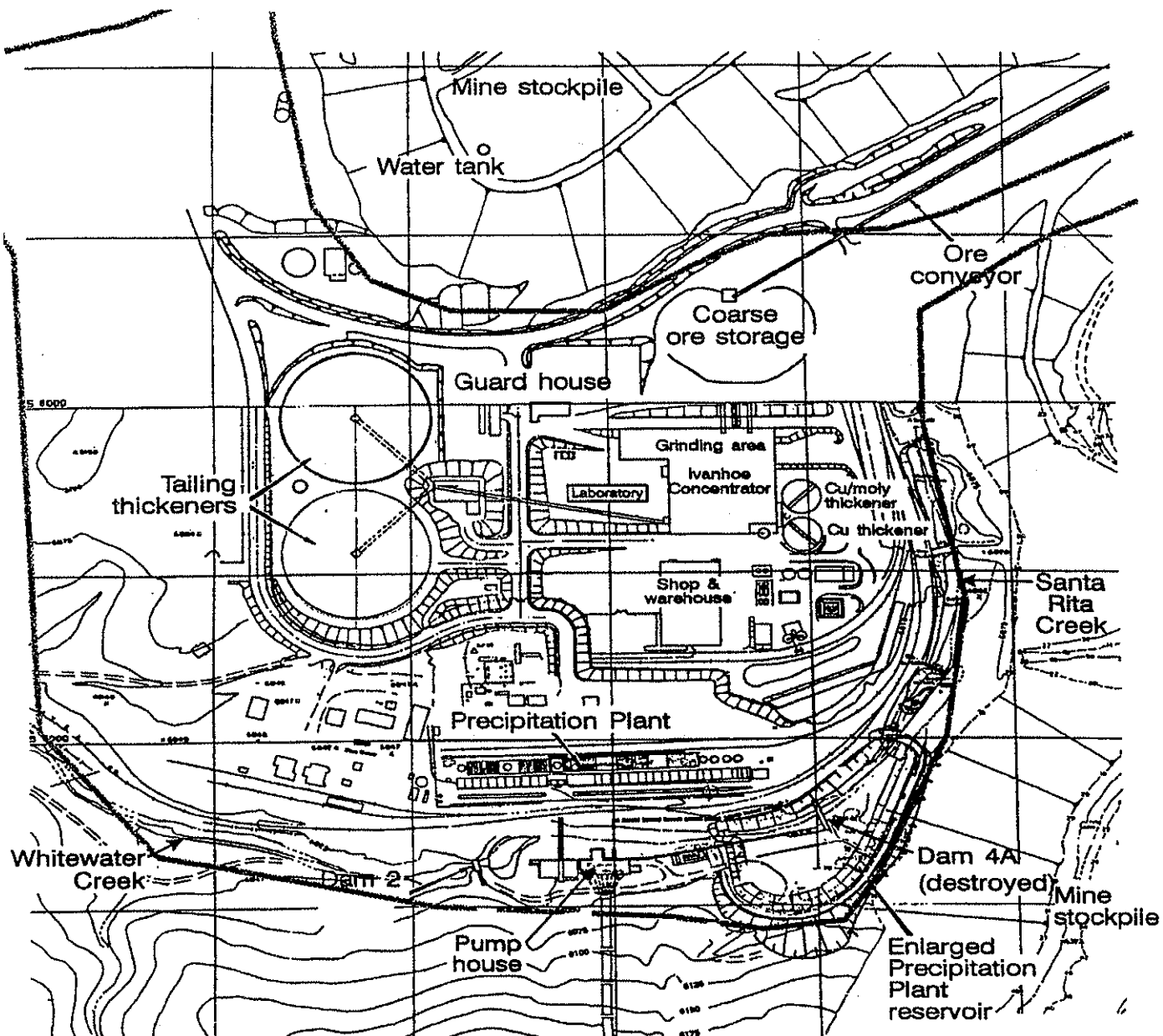


Figure 2-5



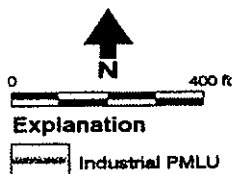
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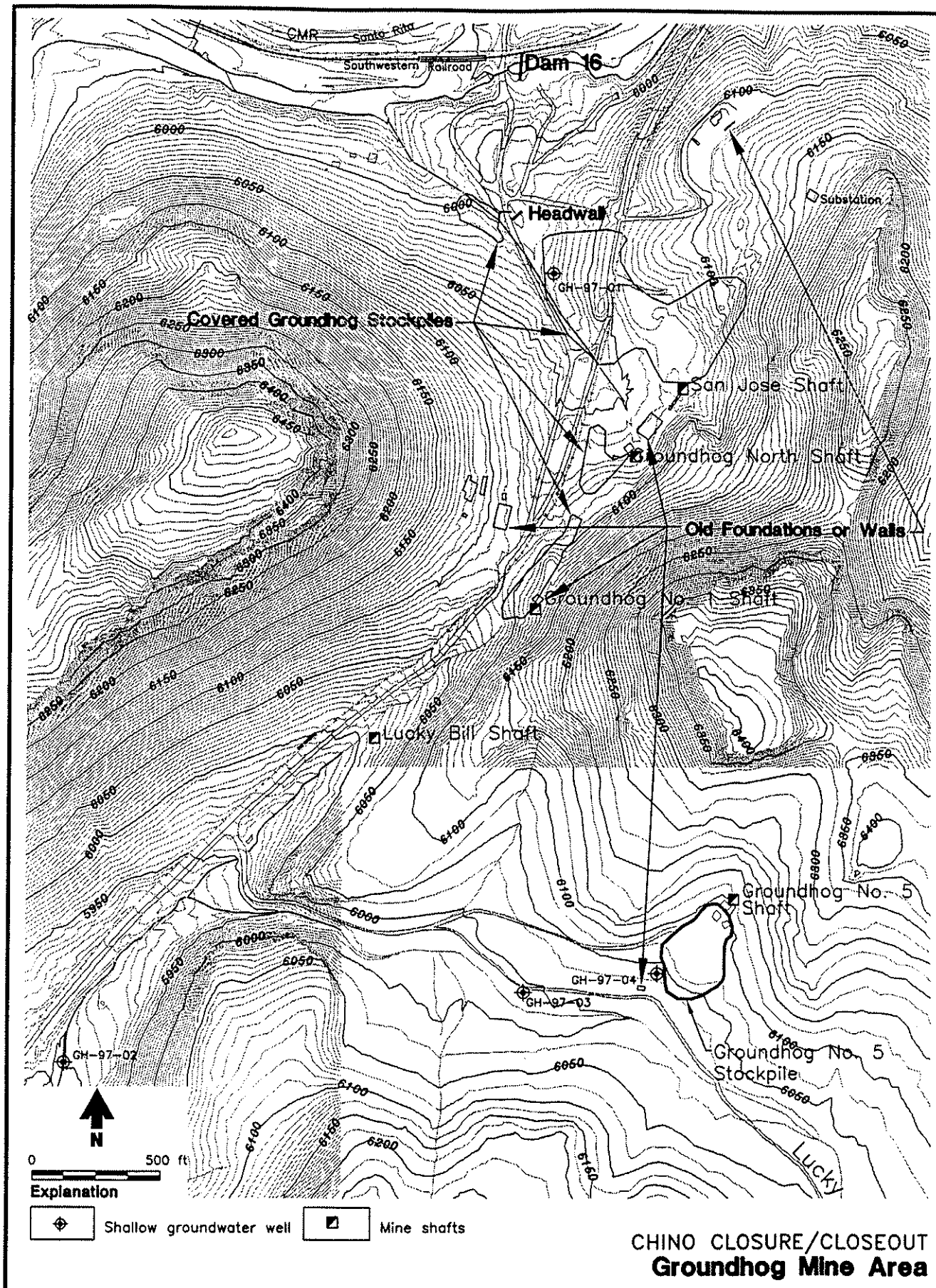


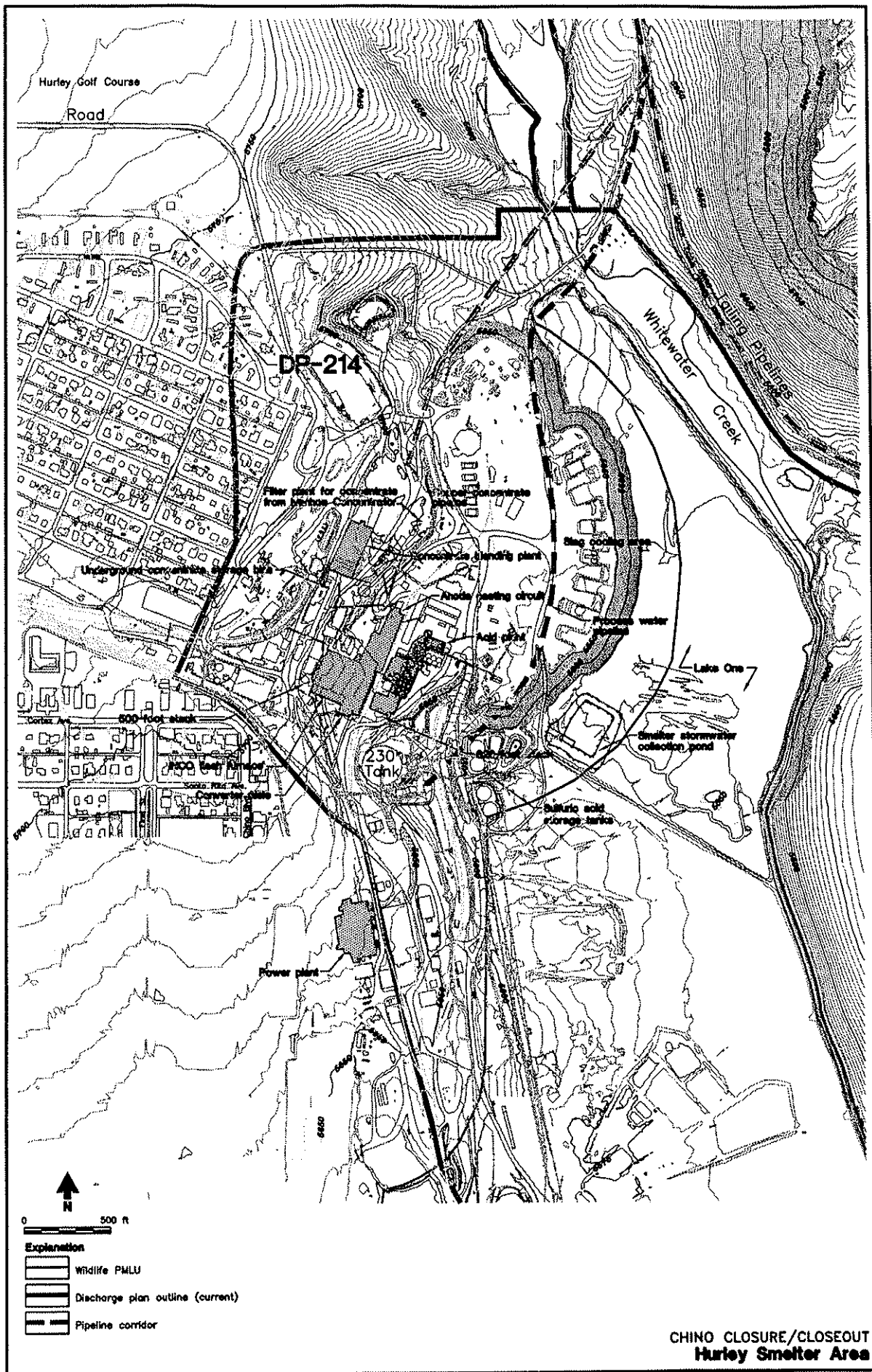
Note: Dams 2 and 4 are inferred to be the lower dam and head dam, respectively.

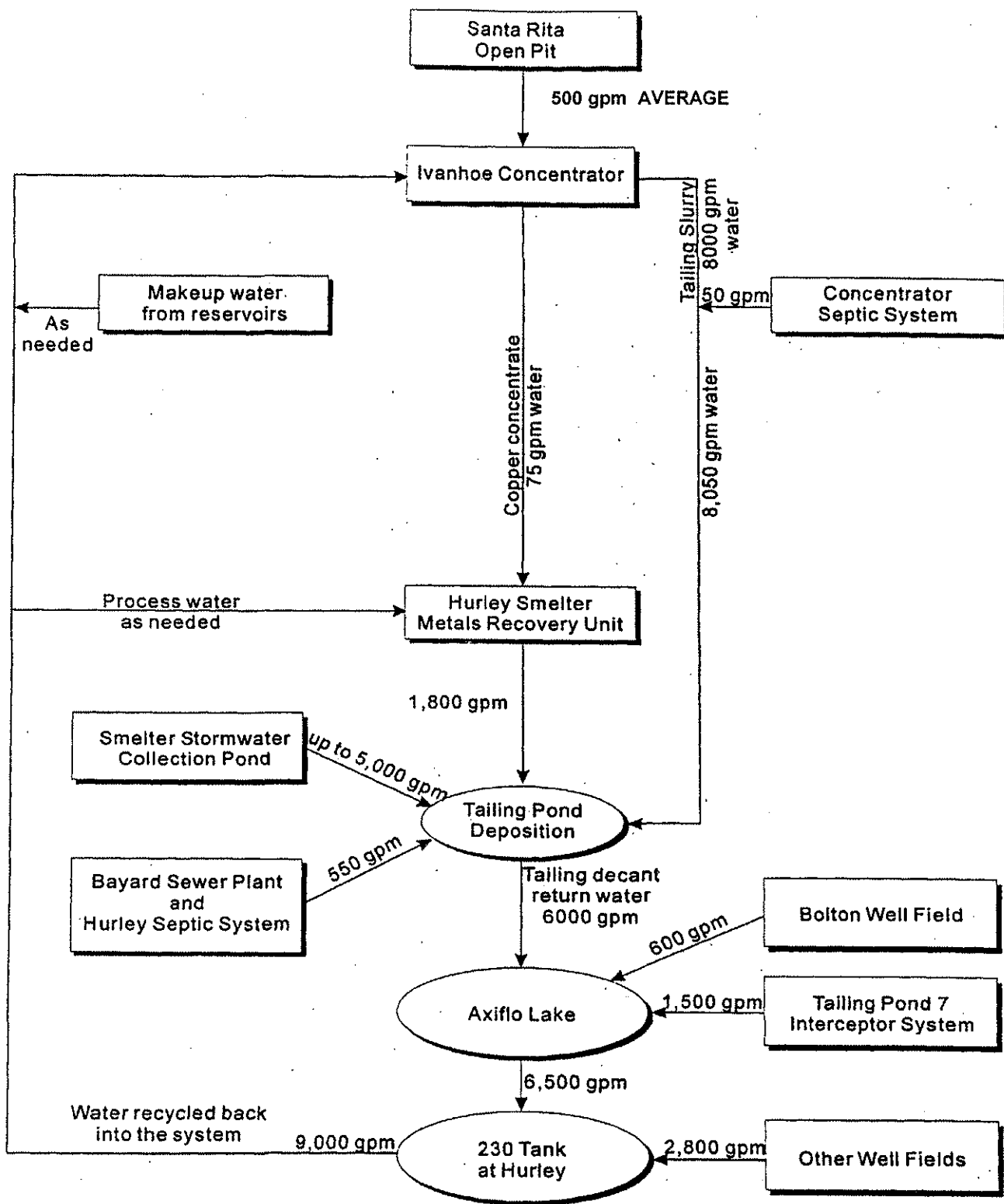
Sources: Modified from Dames & Moore, 1983, Plate 2.
Cu/Moly and Cu thickeners identified from Chino, 1981b, Figure 3.



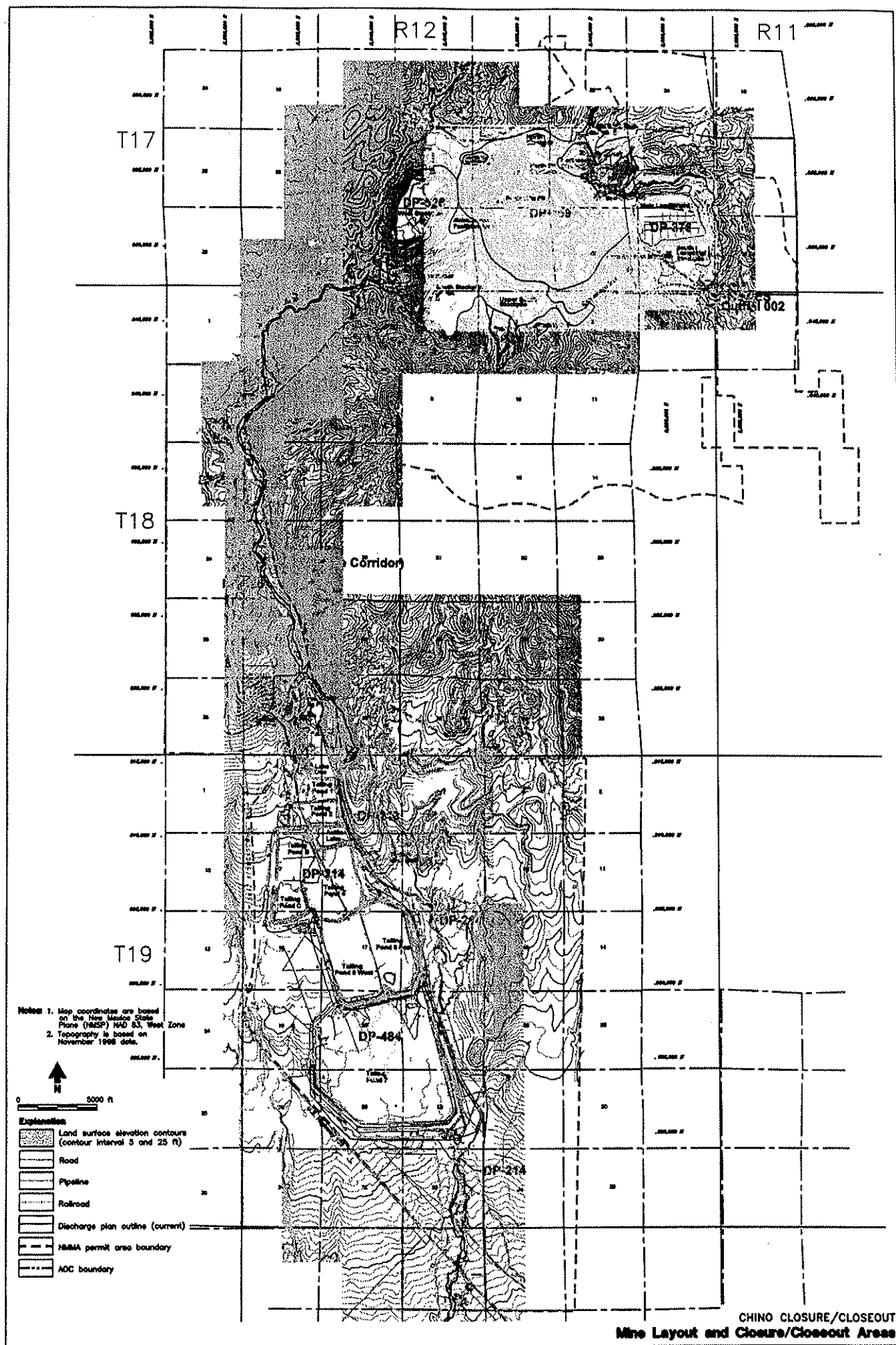
CHINO CLOSURE/CLOSEOUT
Ivanhoe Concentrator/Precipitation Plant Area







CHINO CLOSURE/CLOSEOUT
Water Use and Supply Cycle at Chino Mine



3. Technical Considerations for Reclamation

3.1 Reclamation Plan

All of the Chino Mine facilities have been identified to be within specific areas regulated under various discharge plan (DP) permits, that are administered by the NMED Ground Water Quality Bureau. The reclamation plan for closure/closeout has been developed for each DP area.

Primary facilities in the North Mine Area regulated by DP's include:

- Lampbright stockpiles and Reservoir 8, DP-376 Area
- SX/EW plant and Reservoirs 6 and 7, DP-591 Area
- North stockpiles, Reservoir 5, and Santa Rita Pit, DP-459 Area
- Reservoir 3A, DP-493 Area
- Whitewater stockpiles, Reservoirs 2 and 4A, and Whitewater Creek from the Ivanhoe Concentrator to lake One, DP-526 Area
- Ivanhoe Concentrator and tailing, process water and concentrate pipelines, DP-213 Area

Primary facilities in the South Mine Area governed by DP's include:

- The Hurley Smelter, Lake One, Axiflo Lake, the older tailing ponds, and Lower Whitewater Creek, DP-214 Area
- Tailing Pond 7 and the older Lower Whitewater Creek diversion, DP-484 Area

The following sections identify the facilities, material characteristics, site-specific hydrologic conditions, and the known and potential impacts to the environment associated with each DP area.

3.2 Units of Reclamation

3.2.1 Lampbright Stockpiles and Reservoir 8, DP-376 Area

The primary facilities to be closed in the DP-376 area are the Lampbright stockpiles, which are located east of the Santa Rita open pit and southeast of the SX/EW plant, and Reservoir 8, located at the southern foot of the Lampbright stockpile in Tributary 1.

The facilities are shown on Drawings Chino-11, 12, and 26, Appendix B.

3.2.1.1 Material Characteristics

The DP-376 area contains two primary materials to be characterized, leach-grade ore and waste rock.

Both the leach-grade ore and waste rock that have been placed in stockpiles range in size from very fine (clay and silt) to large boulders. As materials are end dumped and settle at an angle of repose, these materials form a heterogeneous mass. The tops of the leach stockpiles are relatively level.

Approximately 82 percent of the Southwest Lampbright waste rock stockpile can be classified by general geology. Two general geology categories identified in the Chino Resource Model account for about 94 percent of the identified waste rock. Category 5 (Cretaceous sedimentary rocks of the Colorado Formation) accounts for about 80 percent of the identified waste rock, and Category 7 (also referred to as the combination 6/7 because of the similarity of category 6, Cretaceous sills, and category 7, granodiorite of the Santa Rita Stock) accounts for another 14 percent of the identified waste rock. Records for the remaining 6 percent of the waste rock volume are incomplete or not available, but based on mine operations, the bulk of the remaining waste rock also consists of material from general geology categories 5 and 7. Based on static acid-base accounting results, the materials from categories 5 and 7 are interpreted as having the potential to generate acid.

Detailed information on stockpile characterization is found in the following reports in Appendix I:

- Waste Rock Characterization, Chino Mine (GAI, 1998)
- Stockpile Characterization – Chino Mines Company (GAI, 1999)

3.2.1.2 Site-Specific Hydrologic Conditions

3.2.1.2.1 Surface Water

The primary surface drainages in the immediate vicinity of the Lampbright stockpiles are three tributary drainages (Tributaries 1, 2, and 2A) of Lampbright Draw, an ephemeral stream that flows

generally southwest toward Whitewater Creek. Much of Tributary 1 is overlain by the leach stockpiles and has been incorporated into the PLS collection system. Reservoir 8 and several stormwater runoff detention ponds are also located in the Tributary 1 drainage, at the southern toe of the South Lampbright stockpile. The remainder of the Tributary 1 drainage continues to the southeast where it joins Tributary 2, which runs along the north and east sides of the leach stockpiles. Tributary 2A is a drainage area that is immediately east of the Main Lampbright Stockpile and west of Tributary 2.

The North Diversion Channel, which runs just outside the DP-376 area north of the Main Lampbright stockpile, transports excess clean runoff water from the former Upper Santa Rita Creek that drains into the upper part of Reservoir 5 and the former Tributary 1 area north of the stockpile. The channel cuts through the drainage divide between Tributaries 1 and 2 and, during significant precipitation events, discharges to Tributary 2.

Chino is subject to an individual NPDES permit. NPDES Outfall 002 is located immediately down gradient of the Lampbright stockpiles in Tributary 1. Chino classifies this as a "zero discharge" point.

3.2.1.2.2 Groundwater

Groundwater in the DP-376 area occurs in bedrock, in the intrusive diorite and Colorado Formation and in ephemeral alluvial channels. Static depths to water at the site range from less than 5 feet to greater than 100 feet below ground surface (bgs), and water level elevations range from approximately 5,988 (well 379-96-07) to about 6,400 (TLB18S, TLB18D, and TLB32 along the slopes southwest of Tributary 1) feet above msl. The groundwater generally flows to the east and south toward Lampbright Draw, from topographically higher ground to lower ground. Dewatering of the Santa Rita pit may have some influence on the groundwater gradient in minor areas along the western edge of the DP area that are nearest the pit (Drawing Chino-20).

3.2.1.3 Known and Potential Impacts

The Lampbright leach facility includes a number of areas or operations with the potential to affect water, air, or soil and sediment. These include the leach and waste stockpiles, the various surface water impoundments, PLS and raffinate pipelines, an old fueling facility, and haul and access roads. Other potential source areas include the tributaries (1, 2, and 2A) adjacent to the stockpiles. Potential constituents of concern that may be released to the environment by DP-376 facilities include metals, sulfate, TDS, low-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, groundwater, air, and soil or sediment are outlined in Sections 3.2.1.3.1 through 3.2.1.3.4.

3.2.1.3.1 Surface Water

In general, high-quality surface water is found in Lampbright Draw and most of its tributaries. Limited impacts to surface-water quality from the Lampbright stockpiles have occurred in some locations where seeps with impacted water occasionally emerge. Analytical results for samples collected in 1995 from 14 seeps and springs suggested limited effects along Tributaries 2 and 2A at a number of seeps where elevated concentrations of sulfate and TDS were observed. The worst impacts occurred at seep LB-2401, located at the northeast corner of the Main Lampbright stockpile in Tributary 2, where both elevated sulfate and TDS, as well as low pH and elevated metal concentrations, were observed.

Much of the remaining Tributary 1 channel and drainage network has been incorporated into the leach recovery system. Surface water runoff from the stockpile area, which had flowed into Lampbright Draw prior to mining, is now contained by Reservoir 8. Hence, overall runoff in the Lampbright drainage has been significantly reduced compared with pre-mining conditions.

3.2.1.3.2 Groundwater

Water quality data indicate that groundwater in the valley bottom of Tributary 1 at the Lampbright stockpiles is affected by the migration of leach fluids

from the stockpile. However, for the most part the affected groundwater is contained within the permitted leach area boundary. Groundwater quality data indicate the presence of concentrations exceeding applicable standards in groundwater at downgradient locations within the southern portion of the DP-376 area and at locations adjacent to the north and northeast discharge plan boundaries. Elevated concentrations of sulfate, TDS, and chloride have been detected in groundwater on the stockpile flanks west of the Lampbright Draw, but these may be a result of naturally occurring mineral sources. The shape of the potentiometric surface indicates that groundwater flowing from this source may not be completely controlled, but it is adequately monitored.

In 1996, eight wells were installed downgradient of the stockpiles to obtain baseline groundwater constituent concentrations in support of an EIS for a proposed mine expansion. Some of these wells were incorporated into DP-376 and are monitored and sampled quarterly. To date, analytical results for samples from these wells have indicated no impacts except in the immediate vicinity of the leach stockpiles. Groundwater samples from monitor well 376-96-04, located in the channel of Tributary 1 below seep LB-2409 contained concentrations of sulfate, calcium, magnesium, and manganese that are higher than those observed in other wells along the east side of the stockpiles. As required by DP-376 permit conditions, Chino is installing a ground water remediation system in the northeast portion of the discharge plan area to address elevated concentrations of sulfate and metals.

In 1998, two additional monitor wells (CGCS-9 and CGCS-10) were installed in Tributary 2, east of the leach stockpiles. Groundwater samples from these wells were analyzed for a typical suite of groundwater quality parameters. Only the results for CGCS-9, with elevated concentrations of sulfate and TDS, indicated some impacts.

3.2.1.3.3 Air

The Lampbright Stockpiles may be a limited source of wind blown particulate matter. When the mine is in operation, the wetting of haulage roads reduces dust generated from vehicular traffic. When leaching is in operation, the wetting of stockpiles with raffinate likely reduces particulate emissions.

3.2.1.3.4 Soil and Sediment

Impacts to soil may have resulted from the fallout of airborne dust particles that originated on the stockpiles and were covered with residues of leach solutions. In addition, it is likely that some areas of soil and sediment in Reservoir 8 have been affected by the PLS that is collected there. Raffinate, PLS, or stockpile seepage may also affect soils or sediments near some seeps and in channels where seasonal seepage flows. Depending on the severity of the impact, these areas of affected soil or sediment may require removal after the reservoir is drained.

3.2.2 SX/EW Plant and Reservoirs 6 and 7, DP-591 Area

The primary facilities to be closed in the DP-591 area are the SX/EW plant, the PLS feed pond, the raffinate storage tank and overflow pond, Reservoirs 6 and 7 and associated conveyance systems, and an interceptor well.

The facilities are shown on Drawings Chino-11 and 12, Appendix B.

PLS obtained from the stockpile leaching operations is routed from the stockpiles through pipelines for storage in the feed pond. Raffinate from the SX/EW plant is returned to the stockpiles from the raffinate tank.

Both reservoirs are used for storage of stormwater and excess process water during storm events.

3.2.2.1 Material Characteristics

The DP-591 area contains two primary materials to be characterized, PLS (pregnant leach solution) and raffinate.

PLS is the fluid that results from the stockpile leaching operations. PLS is characterized as a low-pH solution containing elevated levels of metals, TDS, and sulfate.

Raffinate, also called barren leaching solution, is the effluent from the SX/EW plant. Raffinate is also characterized as a low-pH solution containing elevated levels of metals, TDS, and sulfate.

Other materials used in the PLS processing operation at the SX/EW plant include kerosene-like organic reagents, electrolyte solutions, and sulfuric acid.

3.2.2.2 Site-Specific Hydrologic Conditions

3.2.2.2.1 Surface Water

The DP-591 area is located within the upper reaches of the Whitewater Creek drainage basin. Stormwater runoff from most of the undisturbed portions of the DP-591 area is routed to the North Diversion Channel, which conveys it to Tributary 2 of Lampbright Draw. All surface runoff from the SX/EW plant site is diverted to the southwest into the raffinate tank. Other surface water features in the DP-591 area include Reservoirs 6 and 7 and the PLS feed pond.

3.2.2.2.2 Groundwater

Groundwater in the DP-591 area occurs in the Colorado Formation (sandstone/shale), Beartooth Quartzite (sandstone), and Syrena Limestone. Groundwater flow beneath the plant site is under hydraulic control of the Santa Rita pit and is generally to the southwest toward the pit. The depth to water ranges from about 20 to 230 feet bgs at elevations ranging from 6,440 to 6,580 feet above msl.

A total of 17 wells have been installed in the DP-591 area. One of these wells is a production well installed to recover impacted groundwater. Discharge from this well is routed to Reservoir 7. The others wells are monitor wells.

3.2.2.3 Known and Potential Impacts

Potential constituents of concern that may be released from DP-591 facilities include metals, sulfate, TDS, low-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, groundwater, air, and soil and sediments are outlined in Sections 3.2.2.3.1 through 3.2.2.3.4.

3.2.2.3.1 Surface Water

No impacts to surface water quality from the SX/EW plant have occurred.

3.2.2.3.2 Groundwater

No off-site groundwater impacts caused by operations at the SX/EW plant and related facilities have occurred. Monitor wells indicate that groundwater in the DP-591 area exceeds applicable standards for sulfate, TDS, and manganese at locations within and adjacent to the eastern boundary of the area and for copper and lead at locations to the south. Groundwater at these areas that is not captured by the interceptor system flows toward the Santa Rita pit.

In 1989 Chino implemented a groundwater remediation program consisting of an interceptor well system. Groundwater that escapes capture by this system will eventually flow to the pit.

3.2.2.3.3 Air

No impacts to air quality from DP-591 facilities have occurred.

3.2.2.3.4 Soil and Sediments

No impacts to soil and sediments in the DP-591 area have occurred.

3.2.3 North Pit Stockpiles, Reservoir 5, and Santa Rita Pit, DP-459 Area

The primary facilities to be closed in the DP-459 area are the North Pit leach and the Northeast, Northwest, and North waste rock stockpiles, Reservoir 5, and the Santa Rita open pit areas.

The facilities are shown on Drawings Chino-11, 12, and 26, Appendix B.

The North Pit stockpiles are low-grade ore, leach, or overburden waste rock stockpiles.

Reservoir 5 collects stormwater runoff.

The Santa Rita pit includes three discrete pit bottoms and associated pit lakes.

3.2.3.1 Material Characteristics

The DP-459 area contains two primary materials to be characterized, leach-grade ore and waste rock. The results of the stockpile characterization studies conducted at Chino indicate that the stockpiles are primarily composed of granodiorite, skarn, and Cretaceous sediments (abbreviated terms for samples representative of general geology codes 6/7, 3 and 5, respectively), which are the predominant material types at Chino.

Both the leach-grade ore and waste rock range in particle size from very fine (clay and silt) to large boulders. When end-dumped, these materials form a heterogeneous mass of materials that settle at the approximate angle of repose. The tops of the leach stockpiles are relatively level and the top perimeter is bermed for safety.

Detailed information on stockpile characterization is found in the following reports in Appendix I:

- Waste Rock Characterization, Chino Mine (GAI, 1998)
- Stockpile Characterization – Chino Mines Company (GAI, 1999)

3.2.3.2 Site-Specific Hydrologic Conditions

3.2.3.2.1 Surface Water

DP-459 covers an area that was originally part of the Santa Rita Creek drainage system. The entire area has been modified by mining operations, and little of the original Santa Rita Creek drainage system remains. All runoff, except for that directed to Reservoir 5, flows directly or indirectly into the Santa Rita open pit, from which it is pumped into the Whitewater Leach System (DP-526).

Current surface water features include the North Pit PLS sedimentation basin, the three pit lakes/sumps, a number of booster sumps, and Reservoir 5.

Reservoir 5 is located north of the leach stockpile and collects runoff that can be used as mine process water; excess clean water runoff is routed to the North Diversion Channel.

3.2.3.2.2 Groundwater

Groundwater occurs in both the intrusive formations in the North Pit stockpile area and in limestones to the north and east. Depths to groundwater range from less than 15 feet bgs to greater than 200 feet bgs. Hydraulic gradients show that flow is toward the Santa Rita pit. Groundwater seeps, downgradient of the leach stockpile, flow toward the pit.

3.2.3.3 Known and Potential Impacts

The North Pit leach facility permitted under DP-459 includes a number of areas or operations with the potential to affect water, air, or soil and sediment. These include the leach and waste stockpiles, the various impoundments and sumps, old sediments in the southern portion of Reservoir 5, PLS and raffinate pipelines, and haul and access roads. Potential constituents of concern that may be released to the environment by DP-459 facilities include metals, sulfate, TDS, low-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, groundwater, air, and soil and sediment are outlined in Sections 3.2.3.3.1 through 3.2.3.3.4.

3.2.3.3.1 Surface Water

No off-site impacts to surface-water quality from the North Pit leach stockpile have occurred. To prevent future impacts, surface water runoff from the stockpile area is now directed into the Santa Rita pit or the North Diversion Channel rather than being allowed to enter the Whitewater Creek drainage. Pit water and runoff into the pit has a low pH and may contain elevated concentrations of metals, sulfate, and TDS.

3.2.3.3.2 Groundwater

Leaching operations at the North Pit stockpile has resulted in localized groundwater quality similar to PLS. However, impacted groundwater is collected and processed at the SX/EW plant to recover copper. In addition, the three sumps (or pit lakes) at the bottom of each of the Santa Rita pit areas collect runoff and mine water, thus preventing any impact to groundwater quality outside the pit. Groundwater chemistry data from a number of wells in the DP-459 area, most of them located downgradient of the DP-459 stockpiles, indicate that groundwater constituent concentrations from the DP-459 area exceed applicable standards at locations west and southwest of the North Pit stockpile source area. However, these wells lie within the capture zone of the Santa Rita pit.

In 1998, two additional monitor wells were installed downgradient of the Northwest waste rock (CGCS-7) and the North Pit leach (CGCS-8) stockpiles. Groundwater samples from these wells were analyzed for a typical suite of groundwater quality parameters. The results for both samples indicated significant impacts, with concentrations of metals, sulfate, and TDS above applicable standards. The sample from CGCS-8 also had a pH of 3.66 and very high concentrations of metals, sulfate, and TDS.

3.2.3.3.3 Air

The North Pit Stockpiles and the Santa Rita may be a source of wind blown particulate matter. When the mine is in operation, the wetting of haulage roads reduces dust generated from vehicular traffic. When leaching is in operation, the wetting of the North Pit Leach Stockpile with raffinate likely reduces particulate emissions.

3.2.3.3.4 Soil and Sediment

It is likely that some areas of soil and sediment in a number of the sumps or impoundments have been affected by the PLS or runoff that is collected. In addition, impacts to soil may have resulted from the

fallout of airborne dust particles that originated on the stockpiles and were covered with residues of leach solutions. Raffinate, PLS, or stockpile seepage may also affect soils or sediments near some seeps and in channels where seasonal seepage flows. Depending on the severity of the impact, these areas of affected soil or sediment may require removal after leaching operations cease.

3.2.4 Reservoir 3A, DP-493 Area

The primary facility to be closed in the DP-493 area is Reservoir 3A. The facilities are as shown on Drawings Chino-11 and 20, Appendix B).

3.2.4.1 Material Characteristics

The DP-493 area contains no materials to be characterized.

3.2.4.2 Site-Specific Hydrologic Conditions

3.2.4.2.1 Surface Water

Reservoir 3A is located at the south side of the Santa Rita pit in the former headwaters of Whitewater Creek. The reservoir rests upon the Kneeling Nun Tuff and is located in a natural drainage. It covers an area of 50 acres. All surface drainage is toward the reservoir or, for the drainage basin below the dam, toward the Whitewater Leach System.

3.2.4.2.2 Groundwater

Regional groundwater occurs at depths ranging from about 110 to 380 feet bgs. The regional flow direction appears to be toward the Santa Rita pit along fractures, joints, and faults in the Kneeling Nun Tuff. Currently, three monitor wells are installed in the regional groundwater aquifer along the northwest, north, and northeast sides of the reservoir.

3.2.4.3 Known and Potential Impacts

Potential constituents of concern that may be released from Reservoir 3A include metals, sulfate, TDS, and low-pH solutions. Known and potential releases of these constituents to surface water, groundwater, air, and soil and sediment are outlined in Sections 3.2.4.3.1 through 3.2.4.3.4.

3.2.4.3.1 Surface Water

No impacts to off-site surface-water quality from Reservoir 3A have occurred. The reservoir intercepts runoff from the former headwaters of Whitewater Creek; hence, flow in Whitewater Creek downstream of the precipitation plant is reduced from pre-mining conditions. Water in areas where runoff is collected by the South stockpile and not captured in Reservoir 3A is pumped into the water management system.

3.2.4.3.2 Groundwater

The results of potentiometric surface evaluation indicate that regional groundwater flow beneath the DP-493 area is primarily controlled by the Santa Rita pit.

Groundwater quality data suggest that Reservoir 3A has potentially affected groundwater immediately northwest and east of the reservoir at concentrations exceeding applicable standards. Seepage from Reservoir 3A is between 80 and 200 gpm and flows toward the pit, where it is intercepted by the dewatering system.

3.2.4.3.3 Air

Reservoir 3A causes no impacts to air quality.

3.2.4.3.4 Soil and Sediment

Residual iron staining is present west of Reservoir 3A where an evaporative fogger was operated until early 1995. No other impacts to soil and sediment have occurred. It is likely that some areas of soil and sediment in the reservoir have been affected at times

by water quality. Depending on the severity of the impact, these areas of affected soil or sediment may require removal or cover if the reservoir is drained.

3.2.5 Whitewater Stockpiles and Facilities, DP-526

The DP-526 area includes a large part of the Chino Mine that lies west and southwest of the Santa Rita pit. The primary facilities to be closed are low-grade ore and waste/overburden stockpiles, reservoirs and other facilities associated with the Mine's water management system, the former precipitation plant area, other ancillary facilities, and the reach of Whitewater Creek down to Lake One. These facilities are shown on Drawings Chino-11, 12, and 26, Appendix B.

3.2.5.1 Material Characteristics

The DP-526 area contains two primary materials that have been characterized, leach-grade ore and waste rock. The results of the stockpile characterization studies conducted at Chino indicate that the stockpiles are primarily composed of granodiorite, skarn, and Cretaceous sediments (abbreviated terms for samples representative of general geology codes 6/7, 3 and 5, respectively), which are the predominant material types at Chino. Detailed information on stockpile characterization is found in the following reports in Appendix I:

- Waste Rock Characterization, Chino Mine (GAI, 1998)
- Stockpile Characterization – Chino Mines Company (GAI, 1999)

Both the leach-grade ore and waste rock range in particle size from very fine (clay and silt) to large boulders. When end-dumped, these materials form a heterogeneous mass of materials that settle at the approximate angle of repose. The tops of the leach stockpiles are relatively level and the top perimeter is bermed for safety.

3.2.5.2 Site-Specific Hydrologic Conditions

3.2.5.2.1 Surface Water

The surface water hydrology of the DP-526 area is dominated by ephemeral stream channels cut into a relatively high-relief terrain. Open-pit mining and the construction of leach and waste/overburden stockpiles and water management facilities have had a marked

effect on the surface drainage network. Portions of the headwaters of both Santa Rita and Whitewater Creeks have been cut off, and additional areas of these drainages are now buried by stockpiles.

The current heads of Santa Rita and upper Whitewater Creeks originate in the mine maintenance facilities area. These creeks flow between the West and South stockpiles into the PLS collection tank and Reservoir 4A or, under extreme conditions, into the new reservoir behind Dam 17. Stormwater in Hanover Creek flows along the western perimeter of the West stockpile and joins Whitewater Creek just west of Dam 16. The reach of upper Whitewater Creek from the precipitation plant to Lake One has recently been added to DP-526.

Hanover Creek is ephemeral, containing limited flows (i.e., less than 50 gpm) for much of the year. However, because it originates in higher ground northwest of Chino, peak flows have been observed in it during periods when no local precipitation is occurring. In June 1992, two 60-degree, V-notch, sharp-crested weirs were constructed in Hanover Creek to measure peak flows and base flows. The bases of the weirs are keyed in bedrock to limit underflow. One weir is located upstream from the stockpiles and south of the Highway 152 bridge, and the second weir is located downstream from the stockpiles and north of the confluence of Hanover and Whitewater Creeks. Base flows recorded to date are less than 10 gpm. In contrast, storm flows can easily exceed 4,500 gpm (i.e., 10 cubic feet per second [ft^3/s]) and have been measured as high as 59,250 gpm (i.e., 132 ft^3/s).

Surface water sampling in Hanover Creek also indicates significant variability in water quality parameters. When present, the water in Hanover Creek varies in pH and may contain elevated metals, TDS, and sulfate. The increased metals, TDS, and sulfate observed in the creek appear to correspond to the flow regime, suggesting that they are a result of storm event runoff from other non-Chino mining properties in the Hanover Creek drainage.

Storm water runoff and/or seepage from the West stockpile is collected by 11 storm water containment structures constructed between 1991 and 1996 to prevent runoff from entering Hanover Creek. Surface water runoff collected behind the structures is pumped back to Reservoirs 4A, 6 and 7. In the WD-6, WD-9, and WD-8 areas, these containment structures are associated with shallow groundwater pumpback systems.

Process water is distributed and collected across the DP-526 area and stored in a number of reservoirs and tanks.

Chino is currently subject to an individual NPDES permit. NPDES Outfall 001 is located immediately down gradient of the Reservoir 17 in Whitewater Creek. Chino classifies this as a "zero discharge" point.

3.2.5.2.2 Groundwater

Groundwater in the DP-526 area is found in the alluvium of channel beds and in weathered and fractured/jointed bedrock located beneath the alluvium, hillslopes, and stockpiles. The alluvium generally consists of unconsolidated coarse sands and gravels derived from intrusive igneous rocks. The bedrock consists chiefly of intrusive igneous rock with some areas of conglomeratic sediments and sedimentary rocks of the Colorado Formation.

There are some indications of an interconnection between surface water and groundwater. Hanover Creek is located along a regional fault structure (Hanover Creek Fault) that probably has a complex hydraulic interconnection to a number of intersecting groundwater regimes.

Prior to placement of the West and South stockpiles and construction of the Ivanhoe Concentrator, several underground mines were worked in the DP-526 area, including the Star, Ivanhoe, and Cooper Glance mines. These underground workings may influence regional groundwater flow.

3.2.5.3 Known and Potential Impacts

The Whitewater leach facility and associated areas permitted under DP-526 include a number of operations with the potential to affect water, air, or soil and sediment. These include the leach and waste stockpiles, the various impoundments and sumps, sediments along channels and in reservoirs or impoundments, PLS and raffinate pipelines, precipitation plant, secondary crusher and conveyor facilities, haul and access roads, and the Santa Rita Class D landfill. Potential constituents of concern that may be released to the environment by DP-526 facilities include metals, sulfate, TDS, low-pH solutions, nitrate, and hydrocarbon or organic compounds. Known and potential releases of these constituents to surface water, groundwater, air, and soil and sediment are outlined in Sections 3.2.5.3.1 through 3.2.5.3.4.

3.2.5.3.1 Surface Water

Prior to construction of the storm water containment structures along the western flanks of the West stockpile, storm water runoff and occasional stockpile seepage entered Hanover Creek, resulting in adverse impacts to water quality. The current containment dams along the West stockpile prevent impacts to Hanover Creek from runoff originating on the Whitewater stockpiles, and the reservoirs below the South stockpile prevent impacts to middle Whitewater Creek from that stockpile.

3.2.5.3.2 Groundwater

Water quality data from numerous wells within the DP-526 area indicate that groundwater surrounding the West stockpile has been affected by past leaching operations and natural infiltration through the stockpile. Potential off-site groundwater impacts from the West stockpile appear to be restricted to a narrow zone between the stockpile and the Hanover Creek channel.

Impacted groundwater appears to be concentrated in discrete fracture zones that discharge toward Hanover Creek. For this reason, many of the monitor wells completed in fracture zones have been converted to interceptor wells to capture seepage before it can enter Hanover Creek and upper Whitewater Creek.

The pumping systems in these wells maintain water levels at a constant elevation below the base of Hanover Creek, thus preventing discharge to the creek channel.

Groundwater flow that might discharge to upper Whitewater Creek appears to be influenced by underground mine workings. Shallow groundwater seepage has been observed within the Star shaft, and other mine workings known to exist in the vicinity may also intercept seepage. The abandoned underground workings may allow preferential flow of poor-quality groundwater downward into the regional groundwater aquifer.

Seepage from the South Stockpile may have affected groundwater northwest of the South stockpile area at concentrations exceeding applicable standards.

Sediment or bank soils from middle Whitewater Creek may have affected surface water that has likely impacted the groundwater. Historical and off-site mining and mineral processing activities may also have influenced groundwater quality along middle Whitewater Creek.

3.2.5.3.3 Air

During mine and process plant operations, potential impacts to air quality are from crushing and conveyor operations associated with the Ivanhoe Concentrator (DP-213), hauling and dumping activities, and dust blown off the stockpiles. In addition, fine sediment that accumulates in emergency reservoirs and runoff impoundments may be blown onto surrounding areas if these facilities become dry.

Dust control is accomplished by wetting haul roads and sweeping paved surfaces on a periodic basis. The wetting of haulage roads reduces dust generated from vehicular traffic. Also the wetting of stockpiles with raffinate likely reduces particulate emissions.

3.2.5.3.4 Soil and Sediment

There are a number of mechanisms by which soils or sediments have been or will be affected by mine operations. Impacts to soil may have resulted from the fallout of airborne dust particles that originated on the stockpiles and were covered with residues of leach solutions.

It is likely that some areas of soil and sediment in a number of the sumps or impoundments have been affected by the PLS or runoff that is collected. Raffinate, PLS, or seepage may also affect soils or sediments near some seeps and in channels where seasonal seepage flows. For example, before construction of the storm water containment dams storm water runoff and seepage from the nearby slopes of the West stockpile could have affected sediments in these ephemeral channels as well as in Hanover Creek. Depending on the severity of the impact, these areas of affected soil or sediment may require removal after leaching operations cease.

3.2.6 Ivanhoe Concentrator and Tailing Pipelines, DP-213 Area

The facilities to be closed in the DP-213 area are the Ivanhoe Concentrator and associated pipelines. Facilities are shown on Drawings Chino-01, 11, and 26, Appendix B.

3.2.6.1 Material Characteristics

The DP-213 area contains two primary materials that have been characterized, tailing slurry and clarified tailing decant return water (TDRW). Tailing and TDRW chemistry have been characterized and analytical results have been submitted to NMED pursuant to DP-213 requirements.

Tailing slurry is the waste material produced during ore processing activities. In general, the acid generation potential of the tailing exceeds its neutralization potential. However, as tailing slurry, the material is generally basic (pH greater than 7).

Clarified TDRW makes up most of the process water used in the concentrator. Some constituents (TDS, sulfate, molybdenum, and fluoride) in TDRW are elevated above applicable standards.

3.2.6.2 Site-Specific Hydrologic Conditions

3.2.6.2.1 Surface Water

Both the Ivanhoe Concentrator and pipelines are located within the Whitewater Creek drainage basin. Whitewater Creek is an ephemeral stream that flows in the DP-213 area only in response to short-duration, intense precipitation events or at times of significant snow melt runoff. The other major surface water feature in the DP-213 area is Bayard Canyon, an ephemeral tributary of Whitewater Creek. No perennial surface water features are associated with the Ivanhoe Concentrator area. Any surface water runoff from the concentrator is contained by Reservoir 2 in Whitewater Creek.

3.2.6.2.2 Groundwater

The major hydrogeologic unit in the Ivanhoe Concentrator area is quartz diorite porphyry. Regional groundwater flow in this unit is fracture dominated with movement toward Santa Rita Creek. The depth to regional groundwater at the concentrator area is approximately 10 to 20 feet bgs.

The major hydrogeologic unit in the pipeline corridor is an alluvial aquifer of highly permeable stream sediments that occurs along Whitewater Creek. This aquifer consists primarily of gravels and coarse sands with the depth to groundwater ranging from 1 to 10 feet. Several groundwater monitor wells have been installed along Whitewater Creek. The monitor wells indicate that the general flow direction of regional groundwater over most of the length of the pipeline corridor is toward the south.

3.2.6.3 Known and Potential Impacts

Potential constituents of concern produced by or used at facilities permitted under DP-213 include metals, sulfate, TDS, low- or high-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, groundwater, air, and soil and sediment are outlined in Sections 3.2.6.3.1 through 3.2.6.3.4.

3.2.6.3.1 Surface Water

The only impacts to surface water quality in the DP-213 area have been minor temporary impacts resulting from past pipeline spills. Significant impacts to surface water are not expected to occur in the future because of improved stormwater containment and new process water spill containment measures.

3.2.6.3.2 Groundwater

Nine monitor wells near the concentrator are sampled periodically. Historical data from groundwater monitor wells immediately within the Ivanhoe Concentrator area indicates exceedances of applicable standards for several metals, sulfate, and TDS. The likely source of these impacts is the Whitewater Leach System.

Seven monitor wells located near the pipelines are also sampled periodically. No impacts to groundwater from the tailing pipelines have occurred.

3.2.6.3.3 Air

During process plant operation, potential impacts to air quality are from crushing and conveyor operations and the lime plant associated with the concentrator. Particulate air emissions from these facilities are subject to an air permit issued by the NMED Air Quality Bureau.

3.2.6.3.4 Soil and Sediment

There are no impacts to soil or sediment from the pipelines or ore processing activities at the concentrator. A number of tailing pipeline spills have occurred. These spills and any impacted soils or sediments were remediated.

3.2.7 Hurley Smelter, Lower Whitewater Creek and Older Tailing Ponds, DP-214 Area

The primary facilities to be closed in the DP-214 area are the Hurley Smelter, Lake One, Axiflo Lake, and the older tailing ponds. Several ancillary facilities to be closed are present at both the smelter area and the older tailing ponds.

The facilities are shown on Drawings Chino-01, 02, and 26, Appendix B.

3.2.7.1 Material Characteristics

The DP-214 area primarily contains tailing. Tailing is the waste material produced during ore processing activities. Tailing in the older tailing ponds was produced by operation of the former Hurley concentrator.

Laboratory analyses of tailing samples indicate that acid generation potential exceeds acid neutralization potential in all the older tailing ponds. Analyses of vadose and perched water samples from the older tailing ponds demonstrate that these waters are in most cases not degraded chemically, relative to TDRW. The water returned from the tailing ponds usually retains a pH greater than 9.

The vadose and perched water from the older tailing ponds generally exceeds applicable standards only for boron, manganese, sulfate, and TDS. The boron and manganese are inferred to be from naturally occurring sources.

Detailed information on older tailing geochemistry is available in the following reports in Appendix H:

- Existing Data Report, Chino Mine Tailing Ponds, Volume 1: Sections 1 through 6 (DBS&A, 1996)
- Phase 1 Investigation, Chino Mines Company, Older Tailing Source Area, Volume 1: Sections 1 through 11 (DBS&A, 1997)

3.2.7.2 Site-Specific Hydrologic Conditions

3.2.7.2.1 Surface Water

The DP-214 area is located within the Whitewater Creek drainage basin. Whitewater Creek is an ephemeral stream that flows in the DP-214 area only in response to short-duration, intense thunderstorms or during times of major snowmelt runoff. Other surface water features in the DP-214 area include Axiflo Lake, the dry lake bed of Lake One, the Hurley Smelter discharge elimination system, James Canyon and Bolton Draw (ephemeral tributaries to Whitewater Creek), and an unnamed ephemeral drainage that runs from Hurley past the west sides of Tailing Ponds B and C and joins Whitewater Creek below the mine area.

3.2.7.2.2 Groundwater

A total of 79 monitor wells have been installed in the DP-214 area. Four of the Bolton production wells are also located in the DP-214 area. DP-214 monitor wells are located mainly along the eastern edge of Whitewater Creek and to the south and west of the older tailing ponds. The monitor wells are completed at various depths in the Gila Conglomerate, the volcanics, and the alluvium.

The regional water table generally lies at depths of less than 10 feet bgs in the stream channel alluvium of Whitewater Creek north of Lake One. In the area of Lake One, the water table declines in elevation and passes into the Gila Conglomerate, which becomes the regional water table aquifer in the DP-214 area south of Lake One. The depth to water at the southeast end of Lake One was about 80 feet bgs in March, 1996 and about 165 feet bgs just south of Tailing Pond 7 in May 1996. The overall groundwater flow direction is generally toward the south to south-southeast in the DP-214 tract (Drawing Chino-21, Appendix B).

Perched water might be expected to occur in paleochannels eroded into the Gila Conglomerate or subjacent volcanic units that are partially filled with alluvium. Limited observations of perched water in the DP-214 area are documented; for example, a well drilled downstream of Pond 7 in the Whitewater Creek drainage encountered perched water at a depth of 60 feet bgs.

3.2.7.3 Known and Potential Impacts

Potential constituents of concern that may be released from DP-214 facilities include metals, sulfate, TDS, low- and high-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, groundwater, air, and soil and sediment are outlined in Sections 3.2.7.3.1 through 3.2.7.3.4.

3.2.7.3.1 Surface Water

Applicable standards for copper and several other metals were exceeded on at least four sampling dates at surface water sampling stations located on Whitewater Creek near the inlet to Lake One and approximately 2 miles south of Tailing Pond 7.

Water in Axiflo Lake is mostly a composite of TDRW, makeup water from the Bolton well field, and groundwater pumped by the Tailing Pond 7 interceptor well system. Samples of Axiflo Lake water collected between 1989 and 1994 had pH values of 6 to 8 and contained approximately 900 to 2,100 milligrams per liter (mg/L) of sulfate and 1,500 to 3,000 mg/L of TDS.

Storm water runoff from Smelter and Older Tailing area is managed on site by a series of berms, reservoirs and other best management practices that minimize discharges to Whitewater Creek.

3.2.7.3.2 Groundwater

A study of regional groundwater quality beneath and near the older tailing ponds and Whitewater Creek from Tailing Pond 7 to its confluence with San

Vicente Arroyo concluded that groundwater in this area has been impacted by mining and mineral processing activities. Groundwater samples from these areas commonly contained concentrations of sulfate and TDS above applicable standards and concentrations of various metals above applicable standards in some samples. In addition, samples of perched water collected from a well located within the active channel of Whitewater Creek downstream from Pond 7 at a depth of 60 feet bgs showed sulfate concentrations above applicable standards. Potential sources of these contaminants include TDRW, and possibly impacted sediments in Whitewater Creek. However, the ultimate sources of many of the elevated constituents are past releases of water from the precipitation plant reservoir and the Hurley Smelter and concentrator.

The majority of the degraded groundwater in the DP-214 area has the potential to eventually be captured by the Tailing Pond 7 interceptor well system. A 1998 study included capture zone modeling of the Tailing Pond 7 area using the analytical modeling code AqModel. The study concluded that groundwater flowing beneath the eastern half of Tailing Pond 7 is being captured by the system, but that capture was incomplete along the western portion of Tailing Pond 7. Additional interceptor wells have been recently installed to contain and remove this impacted water from the aquifer.

Other DP-214 area facilities that have the potential to affect groundwater quality.

- Axiflo Lake (TDRW)
- The Hurley Smelter Class D solid waste landfill (leachate)
- The soil landfarm on Tailing Pond 1 (hydrocarbons)
- Pipelines transporting tailing or TDRW

3.2.7.3.3 Air

Air quality in the DP-214 area may be affected by the Hurley Smelter when it is in operation and windblown dust, principally from the tailing ponds. The Hurley smelter and power plant operate pursuant to air permits issued by NMED and EPA.

Present-day emissions from the smelter stack comply with applicable regulatory standards. A significant area of the older tailing ponds have been capped to minimize wind blown dust.

3.2.7.3.4 Soil and Sediment

Samples of sediments from the Whitewater Creek channel in the DP-214 tract contained concentrations of various metals (most commonly copper and iron) above maximum reference levels. The source of these constituents is inferred to be releases of water from the historic precipitation plant operation, from which leach plant tail water and other process solutions flowed into Whitewater Creek.

Surface soil samples collected over a 2.4-mile-wide area east (i.e., downwind) of the Chino tailing ponds contained copper concentrations elevated above those of a reference set collected west (upwind) of the ponds. These sampling results suggest that tailing blown off the tailing ponds has impacted soils to the east. This area of impact is being managed under the AOC.

A total of 28 samples were collected from surface soils and test pits south of Pond 7. These included samples from two control populations, one representing a mineralized source terrain (provenance to Whitewater Creek, but unaffected by mining operations) and the other an unmineralized source terrain (Lampbright Draw). The results of the analyses suggested that metals concentrations in control samples were similar or higher than in samples collected along Whitewater Creek.

3.2.8 Tailing Pond 7, DP-484 Area

The primary facilities to be closed in the DP-484 area include Tailing Pond 7 (and ultimately the interceptor well field) and auxiliary structures and equipment such as the pipelines and the crane-mounted cyclones.

The facilities are shown on Drawings Chino-02, 06, and 26, Appendix B.

3.2.8.1 Material Characteristics

The primary material to be characterized in the DP-484 area is tailing.

Tailing is the waste material produced during ore processing facilities. Tailing in Tailing Pond 7 was processed by operation of the Ivanhoe Concentrator. Tailing chemistry has been characterized and analytical results have been submitted to NMED pursuant to DP-213 requirements.

3.2.8.2 Site-Specific Hydrologic Conditions

3.2.8.2.1 Surface Water

The DP-484 area is located within the Whitewater Creek drainage basin. Whitewater Creek is an intermittent stream that flows in the diversion channel located a short distance east of Tailing Pond 7 and only in response to short-duration, intense thunderstorms or at times of major snowmelt runoff. Other surface water in the DP-484 area includes process water used to transport the tailing, runoff from the south slope of Tailing Pond 6, and water from other permitted discharges that accumulates in the Tailing Pond 7 decant pond.

3.2.8.2.2 Groundwater

A total of 61 wells have been installed in the DP-484 area. Of these wells, 18 are production/extraction wells in the interceptor well system at the south and southwest end of Tailing Pond 7 and 43 are monitor wells. Most of these wells are completed in the Gila Conglomerate. (These numbers have changes since the RCCP was submitted. Shomaker installed

additional wells associated with the No. 7 interceptor system.)

Depth to regional groundwater ranges from about 50 to 200 feet bgs at elevations of approximately 5,330 to 5,070 feet above msl.

The potentiometric surface beneath Tailing Pond 7 is locally mounded such that groundwater flow directions are approximately westward to southwestward near the western edge of the Tailing Pond, southward near the southern edge, and eastward near the eastern edge. The interceptor system at the south side of Tailing Pond 7 controls the groundwater flow direction for most of the DP-484 area. The system has induced a gradient reversal in the water table along the southeast boundary of Tailing Pond 7 that prevents groundwater from flowing southward in this area. Groundwater in the DP-484 area that is not influenced by either the mounding beneath Tailing Pond 7 or the interceptor well system flows toward the south.

A perched zone was identified near the southeast corner of Pond 7 by surface geophysics and borehole drilling. The perched zone was situated in the sediments of the old Whitewater Creek channel between 12 and 25 feet bgs and was about 700 feet wide (east-west) and underlain by a clayey zone. The horizontal flow rate through the perched interval was estimated at 100 to 300 gpm under a hydraulic gradient of 0.012 ft/ft toward the south. Test pits at the toe of Tailing Pond 7 have also reportedly encountered perched water.

3.2.8.3 Known and Potential Impacts

Potential constituents of concern that may be released to the environment by DP-484 facilities include metals, sulfate, TDS, low- and high-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, groundwater, air, and soil and sediment are outlined in Sections 3.2.8.3.1 through 3.2.8.3.4.

3.2.8.3.1 Surface Water

Seepage was observed January 1996 in the diversion channel just east of Tailing Pond 7. These flows were apparently issuing from the western side of the diversion channel (i.e., the side bordering the tailing pond). Values of field water quality parameters (pH and electrical conductivity) exhibited by these flows were similar to those exhibited by TDRW in Tailing Pond 7, suggesting that the flows seeped from the tailing pond. The Lower Whitewater Creek diversion was constructed in 1997 to prevent this seepage from entering the creek.

Storm water runoff from Tailing Pond 7 is managed on site by a series of berms and other best management practices that minimize discharges to Whitewater Creek.

3.2.8.3.2 Groundwater

Groundwater potentially impacted by operations covered under DP-484 is under the control of the Tailing Pond 7 interceptor well system and sump. Groundwater directly downgradient of Tailing Pond 7 has been potentially impacted. Wells in this area have concentrations of sulfate and TDS in excess of NMWQCC standards, with Tailing Pond 7 being the inferred source of these constituents. Other potential sources of impact to groundwater quality in the DP-484 area are (1) the pipelines transporting tailing and TDRW and (2) sediments that are now beneath Tailing Pond 7 in the natural channel of Whitewater Creek.

The perched interval near the southeast corner of Tailing Pond 7 also contains sulfate concentrations above applicable standards. The source of the elevated sulfate is uncertain. Potential sources are Tailing Pond 7, which is leaking high-sulfate water, and soluble salts in sediments in the natural Whitewater Creek channel that were previously impacted by overflows from Lake One and the precipitation plant.

3.2.8.3.3 Air

Tailing Pond 7 is an active pond. The surface of the pond is wet, and portions of the outslopes have been capped to reduce wind blown dust.

3.2.8.3.4 Soil and Sediment

Impacts to soil and sediment may result from wind blown tailing, seepage water from the tailing pond discharging into the old Lower Whitewater Creek diversion channel.

4. Post-Mining Land Use Designation

Livestock grazing and wildlife habitat are the predominant land uses surrounding Chino. Based upon the requirements of NMMA Section 69-36-11.6 and Subparts 507.A and 507.B of the NMMA Rules (MMD, 1996a), this section provides Chino's proposed post-mining land use (PMLU) for the permit area as a whole and specific facilities at Chino. Wildlife habitat is the primary PMLU for the majority of the permit area, with an industrial PMLU designated for the main mine facilities area, including the SX/EW plant area, the mine maintenance facilities area, and the Ivanhoe Concentrator area.

Consistent with Subpart 507.B, some areas of the mine may qualify for a waiver of the requirement of establishing a PMLU. Drawing Chino-31 in Appendix B provides an overview of the locations and extents of the proposed PMLU, pit and stockpile waiver area designations for the entire permit area. Facility boundaries, like the pit or stockpile perimeters, may change as mining progresses, therefore, the PMLU and waiver area boundaries will be modified to correspond to changes in facility structure coincident with the 5-year NMED DP renewals. The configuration of the mine upon closing will define the final extent of the PMLU designations.

The proposed PMLU's for each facility were selected on the basis of the site characteristics and the following guidelines:

- Make the PMLU compatible with the surrounding ecosystem and land use.
- Use the existing infrastructure and land resources to the extent possible.
- Maintain economic viability for Chino and the surrounding community.

The selection of the wildlife habitat PMLU is discussed in Section 4.1. Section 4.2 presents the rationale Chino used for designating an industrial PMLU for some of the facilities and provides details regarding the efforts to achieve the PMLU. Section 4.3 details the vegetation success guidelines that will be applied to demonstrate reclamation of the mine.

4.1 Wildlife Habitat Post-Mining Land Use

The NMMA Rules define the post-mining land use as "a beneficial use or multiple uses which will be established on a permit area after completion of a mining project. The post-mining land use may involve active management of the land. The use shall be selected by the owner of the land and approved by the Director [of MMD]. The uses which may be approved as post-mining land uses may include agriculture, commercial or ecological uses that would ensure compliance with Federal, State or local laws, regulations and standards and which are feasible." The post mining land uses currently approved by the MMD include:

- 1) Cropland
- 2) Pasture land or land occasionally cut for hay
- 3) Grazing land
- 4) Forestry
- 5) Residential
- 6) Industrial/commercial
- 7) Recreation or tourism
- 8) Wildlife habitat
- 9) Developed water resources
- 10) Scientific or educational

Of the MMD-approved post-mining land uses, grazing land and wildlife habitat are the designations most consistent with the surrounding land uses and ecological potential of the site, excluding the areas designated as industrial/commercial. Chino selected the wildlife habitat PMLU in deference to a grazing land designation to preclude long-term grazing management issues. The wildlife PMLU was selected in recognition that wildlife cannot practically be excluded from the reclaimed areas and that they would use the area even if grazing land was selected as the PMLU.

Reclamation will result in the development of an early-stage grass/shrub community that will provide a locally important increase in community-level diversity and some infrastructure may have a post-mining wildlife use (e.g., power poles may serve as raptor perches, main roads may assist in land management, and adits may be used by ringtail cats and bats).

Native vegetation will be established on the reclaimed areas at Chino resulting in increased erosion protection, direct habitat improvement, and reduced percolation of water into the underlying materials relative to current conditions. Proposed reclamation seed mixes and seeding rates for the North and South Mine Areas at Chino are presented in Tables 4-1 and 4-2, respectively. These species have broad ecological amplitudes and provide structural diversity.

The primary reclamation seed mix proposed for the wildlife habitat PMLU areas at the Chino Mine includes cool and warm season grasses, perennial shrubs, and forbs. Depending on availability, alternate species may be substituted for the primary species. The seed mixes are designed for application prior to the summer rains, and the seeding should therefore be completed in early to mid-July. The ratio of cool season to warm season grasses should be adjusted if the seeding is conducted after the summer rains.

The proposed seed mix was selected to provide early establishment of ground cover, erosion control, and diversity in growth forms. The species selected for the Chino Mine have been successfully used in mine reclamation and range improvement projects in many parts of New Mexico. With the exception of yellow sweet clover, all the species are native, and most occur at the Chino.

Yellow sweet clover was included in the mix because it may improve the nitrogen status of the topdressing if the seeds are inoculated with viable bacteria.

Table 4-3 lists some of the major attributes of the vegetation selected for use at the Chino Mine. The selected vegetation will provide erosion control, promote soil development, and provide forage, seeds, and cover for small mammals and birds. The seed mix includes a number of valuable, nutritious forage and browse species that could be used by large mammals.

4.2 Industrial Post-Mining Land Use

The industrial PMLU will continue the existing type of use; however, the specific industry will change. Possible industries that may be recruited include the electroplating industry to use a modified SX/EW plant and construction companies and sand and gravel operations to use the mine maintenance facilities area or Ivanhoe Concentrator area. Table 4-4 is an anticipated Building Use Register.

The three areas proposed for an industrial PMLU have the infrastructure necessary to support future industrial uses. The buildings are well maintained and most of the areas have significant shop facilities and warehouse storage capacity. All the sites have good road access and the Ivanhoe Concentrator area has railroad access. Electrical power is available in each area, including possible backup power from the existing power plant. Stormwater runoff from the areas is contained within the on-site reservoir system. Finally, ample water rights are available due to the water rights that Chino controls.

The industrial PMLU makes better use of the existing facilities and infrastructure than would demolition with subsequent development of wildlife habitat. In addition, the economic benefit to Chino (through leases) and to the community (through jobs and tax base) would be greater than with any other PMLU.

The current industrial facilities are subject to applicable zoning and local laws. Accordingly, it is reasonably assured that future industrial use is feasible with respect to local zoning requirements.

Chino has committed to maintain erosion controls, structures, equipment, and utilities within the industrial PMLU areas until they are occupied. Chino proposes to cover and reseed non-paved areas within the industrial PMLU areas after mine closure.

Historically and invariably, the salvage of process equipment and process building superstructure materials has exceeded the costs of demolition. Chino is not taking any net credit for demolition/salvage in its financial assurance package. As mentioned, Chino is covering all foundations and mulching/seeding the cover – costs are covered in the financial assurance for such.

4.3 Site-Specific Revegetation Success Guidelines

Section 507.A of the New Mexico Mining Act (NMMA) rules (MMD, 1996) requires that the permit area of an existing mine be reclaimed to a condition that allows the establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding area unless it conflicts with the approved PMLU. Demonstration of the establishment of a self-sustaining ecosystem is made by comparison of the vegetation on the reclaimed areas to vegetation attributes on a reference area and/or technical standards (MMD, 1996).

The MMD recognizes that replication of the pre-mining plant communities after mining is not practical (MMD, 1996). The intent of the reference area characterization is to provide a site-specific, quantitative basis for determining revegetation success. More importantly, the reference areas provide an "ecological barometer" that integrates normal climatic variations to aid in the evaluation of temporal changes or trends in the reclaimed ecosystem. Thus, the reference areas do not represent model plant communities that will be replicated in detail, but rather local indications of the ecological potential of the reclaimed plant communities.

The reclamation success guidelines required by the MMD vary depending on the PMLU. Canopy cover, shrub density, and vegetation diversity are the revegetation success guidelines that are typically used to judge revegetation success on lands designated as wildlife habitat.

The vegetation success guidelines include numerical standards to address the canopy cover and shrub density requirements of the NMMA. The plant diversity guidelines are addressed through a technical standard and are complemented by a qualitative assessment of plant colonization and regeneration to corroborate the establishment of a self-sustaining ecosystem. A detailed description of the vegetation success guidelines is included in DBS&A (1999). The guidelines for revegetation success that apply to Chino are discussed in sections 4.3.1 through 4.3.3.

4.3.1 Canopy Cover

Because of its broad implications for erosion control and ecologically based post-mining land uses, canopy cover is one of the primary criteria for determining reclamation success. Chino has a proportional success guideline for total canopy cover equal to 70 percent of the measured reference area value. The proportional standard was determined based on the interpretation of the community structure and ecological conditions in the reference area. The proportional standard reflects the view that the typical 12-year bond release period does not allow enough time for full maturation of the reclaimed plant community relative to the native sites.

The numerical standard derived from the proportional standard will vary over time to account for temporal differences in canopy cover associated with climatic variations. Thus, the numerical standard may increase or decrease based on reference area measurements, but the proportional standards will remain fixed.

4.3.2 Shrub Density

Shrubs are important components of many reclaimed landscapes. A proportional success guideline of 60 percent (of the reference area) has been accepted by the MMD for shrub density in the reclaimed areas. As with canopy cover, the shrub density standard was determined based on the interpretation of the ecological condition of the reference areas.

4.3.3 Plant Diversity

Species diversity is commonly thought to increase the stability of plant communities. The perceived enhancement of ecological stability is related to the buffering effect that species with different ecological amplitudes provide in response to environmental stresses. A technical, rather than proportional, standard will be proposed for plant diversity.

The plant diversity guidelines for Chino are based on the assumption that site stability is improved by establishing plants with different ecological amplitudes to buffer seasonal and annual fluctuations in climate. Chino understands that creating a monoculture on the reclaimed lands is not desirable, while at the same time, recognizing that the benefits of increased diversity diminish beyond subjective threshold levels that are defined by the reclamation objectives. Thus, the diversity guideline for Chino was developed from a functional perspective, whereby site stability and erosion control are primary performance objectives. In addition, these guidelines were developed in recognition of the limitations associated with the sampling and statistical evaluation of plant communities (i.e., minor components are often not represented in the monitoring data).

The numerical diversity guidelines for Chino are listed in Table 4-5. To summarize, the diversity guideline would be met if the reclaimed area contains at least three warm season grasses and two shrubs, with individual cover levels of at least 1 percent, and one perennial, cool season grass with a minimum cover level of 0.5 percent. For the purposes of this guideline, intermediate-season grasses such as plains lovegrass are considered the functional equivalent of the more traditionally defined cool season grasses. In addition, one non-weedy forb species should occur at a minimum cover level of at least 0.1 percent to meet the proposed diversity guideline. The forb guideline is unqualified with respect to seasonality and could include a perennial, biannual, or annual species.

Table 4-5. Proposed Diversity Guidelines for Chino

Class	Seasonality	Number	Minimum Occurrence (% cover)
Perennial grass	Warm	3	1
Perennial grass	Cool	1	0.5
Perennial shrub	NA	2	1
Forbs	NA	2	0.1

NA = Not applicable

Species diversity on the reclaimed areas is expected to increase with time; however, this process is likely to be slow. Successful colonization depends on the convergence of a seed source and the proper weather conditions; however, even with such an ideal convergence, inter-specific competition, predation, and dispersion mechanisms may limit the establishment of new plants on the reclaimed area. Because of the strong climatic influence on seed production and plant establishment, the rate of colonization is expected to be erratic and potentially slow for many species, with the highest rates of colonization expected to be concentrated in the reclaimed/undisturbed ecotone. Evidence of colonization will complement the numerical diversity guidelines listed in Table 5. No numerical guideline is proposed for colonization, which would be demonstrated by increases in the number of species recognized in the reclaimed area. Information on colonization will be collected and reported to provide evidence of the ability of the reclaimed landscape to support native plants from the surrounding communities. Secondly, observations of colonization provide evidence of regeneration and thus help demonstrate the establishment of a self-sustaining ecosystem required in the NMMA.

The intent of the colonization standard is to provide evidence of the ability of the reclaimed landscape to support plants from the surrounding communities. In addition, observations of colonization provide evidence of regeneration and thus support the demonstration of the establishment of a self-sustaining ecosystem. No numerical standard is proposed for colonization, which will instead be demonstrated by increases in the number of species recognized in the reclaimed area. This information will be obtained from the relative cover data or documented observations along the margins of the reclaimed areas.

**Table 4-1. Proposed Interim Seed Mix and Rates for the North Mine Area
Chino Mine**

Species ^a	Life-Form	Duration ^b	Seasonality	Rate ^{a,c}
<i>Primary</i>				
Blue grama (<i>Bouteloua gracilis</i>)	Grass	Per	Warm	0.25
Side-oats grama (<i>Bouteloua curtipendula</i>)	Grass	Per	Warm	1.25
Black grama (<i>Bouteloua eriopoda</i>)	Grass	Per	Warm	0.10
Green sprangletop (<i>Leptochloa dubia</i>)	Grass	Per	Warm	0.15
Plains lovegrass (<i>Eragrostis intermedia</i>)	Grass	Per	Intermediate	0.05
Bottlebrush squirreltail (<i>Sitanion hystrix</i>)	Grass	Per	Cool	1.25
New Mexico needlegrass (<i>Stipa neomexicana</i>)	Grass	Per	Cool	1.75
Streambank wheatgrass (<i>Agropyron dastachyum</i> v. <i>riparium</i>)	Grass	Per	Cool	1.50
Apache plume (<i>Fallugia paradoxa</i>)	Shrub	Per	NA	0.10
Mountain mahogany (<i>Cercocarpus montanus</i>)	Shrub	Per	NA	1.00
Winterfat (<i>Eurotia lanata</i>)	Shrub	Per	NA	0.60
Yellow sweet clover (<i>Melilotus officinalis</i>)	Forb	Ann	NA	0.15
Globe mallow (<i>Sphaeralcea</i> sp.)	Forb	Per	NA	0.10
Blue flax (<i>Linum lewisii</i>)	Forb	Per	NA	0.15
Total PLS (lb/ac)				8.40
<i>Alternate</i>				
Needle-and-thread (<i>Stipa comata</i>)	Grass	Per	Cool	ND
Thickspike wheatgrass (<i>Agropyron dastachyum</i>)	Grass	Per	Cool	ND
Smooth brome (<i>Bromus inermis</i>)	Grass	Per	Cool	ND
Sand dropseed (<i>Sporobolus cryptandrus</i>)	Grass	Per	Intermediate	ND
Tobosa (<i>Hilaria mutica</i>)	Grass	Per	Warm	ND
Bush muhly (<i>Muhlenbergia porteri</i>)	Grass	Per	Warm	ND
Squawberry (<i>Rhus trilobata</i>)	Shrub	Per	NA	ND
Rubber rabbitbush (<i>Chrysothamnus nauseosus</i>)	Shrub	Per	NA	ND
Prairie coneflower (<i>Ratibida columnaris</i>)	Forb	Per	NA	ND
White sweet clover (<i>Melilotus alba</i>)	Forb	Ann	NA	ND

^aSeed mix and rates are subject to change based on future investigations

^bPer – Perennial; Ann = Annual

^cRate is in pounds of pure live seed (PLS) per acre (lb/ac); substitutions may change seeding rates

NA = Not applicable

ND = Not determined

PLS = Pure live seed

**Table 4-2. Proposed Interim Seed Mix and Rates for the South Mine Area
Chino Mine**

Species ^a	Life-Form	Duration ^b	Seasonality	Rate ^{a,c}
<i>Primary</i>				
Blue grama (<i>Bouteloua gracilis</i>)	Grass	Per	Warm	0.25
Side-oats grama (<i>Bouteloua curtipendula</i>)	Grass	Per	Warm	1.25
Black grama (<i>Bouteloua eriopoda</i>)	Grass	Per	Warm	0.10
Green sprangletop (<i>Leptochloa dubia</i>)	Grass	Per	Warm	0.15
Plains lovegrass (<i>Eragrostis intermedia</i>)	Grass	Per	Intermediate	0.05
Bottlebrush squirreltail (<i>Sitanion hystrix</i>)	Grass	Per	Cool	1.25
New Mexico needlegrass (<i>Stipa neomexicana</i>)	Grass	Per	Cool	1.75
Streambank wheatgrass (<i>Agropyron dastachyum</i> v. <i>riparium</i>)	Grass	Per	Cool	1.50
Apache plume (<i>Fallugia pardoxa</i>)	Shrub	Per	NA	0.10
Rubber rabbitbush (<i>Chrysothamnus nauseosus</i>)	Shrub	Per	NA	0.05
Winterfat (<i>Eurotia lanata</i>)	Shrub	Per	NA	0.60
Yellow sweet clover (<i>Melilotus officinalis</i>)	Forb	Ann	NA	0.15
Globe mallow (<i>Sphaeralcea</i> sp.)	Forb	Per	NA	0.10
Blue flax (<i>Linum lewisii</i>)	Forb	Per	NA	0.15
Total PLS (lb/ac)				7.45
<i>Alternate</i>				
Needle-and-thread (<i>Stipa comata</i>)	Grass	Per	Cool	ND
Thickspike wheatgrass (<i>Agropyron dastachyum</i>)	Grass	Per	Cool	ND
Smooth brome (<i>Bromus inermis</i>)	Grass	Per	Cool	ND
Sand dropseed (<i>Sporobolus cryptandrus</i>)	Grass	Per	Intermediate	ND
Tobosa (<i>Hilaria mutica</i>)	Grass	Per	Warm	ND
Bush muhly (<i>Mohlenbergia porteri</i>)	Grass	Per	Warm	ND
Squawberry (<i>Rhus trilobata</i>)	Shrub	Per	NA	ND
Fourwing saltbush (<i>Atriplex canescens</i>)	Shrub	Per	NA	ND
Prairie coneflower (<i>Ratibida columnaris</i>)	Forb	Per	NA	ND
White sweet clover (<i>Melilotus alba</i>)	Forb	Ann	NA	ND

^aSeed mix and rates are subject to change based on future investigations

^bPer – Perennial; Ann = Annual

^cRate is in pounds of pure live seed (PLS) per acre (lb/ac); substitutions may change seeding rates

NA = Not applicable

ND = Not determined

PLS = Pure live seed

**Table 4-3. Functions and Attributes of the Primary Plant Species
Proposed for the Chino Mine Reclamation Sites**

Species	Character ^a	Attributes and Function
Blue grama (<i>Bouteloua gracilis</i>)	N,P,W,G	Sod and bunch grass providing ground over and forage
Side-oats grama (<i>Bouteloua curtipendula</i>)	N,P,W,G	Bunch grass providing ground cover and forage
Black grama (<i>Bouteloua eriopoda</i>)	N,P,W,G	Bunch grass providing ground cover and forage
Green sprangletop (<i>Leptochloa dubia</i>)	N,P,W,G	Erect bunchgrass; aggressive short-lived nurse plant with forage value
Plains lovegrass (<i>Eragrostis intermedia</i>)	N,P,C,G	Bunch grass providing ground cover and early spring forage
Bottlebrush squirreltail (<i>Sitanion hystrix</i>)	N,P,C,G	Persistent (moderately palatable) bunch grass providing ground cover
New Mexico needlegrass (<i>Stipa neomexicana</i>)	N,P,C,G	Persistent bunch grass providing ground cover and forage
Streambank wheatgrass (<i>Agropyron dastachyum v. riparium</i>)	N,P,C,G	Sod-forming grass providing ground cover and forage
Apache plume (<i>Fallugia pardoxa</i>)	N,P,S	Mid-height shrub providing browse, cover, and erosion control
Mountain mahogany (<i>Cercocarpus montanus</i>)	N,P,S	Mid-height to tall shrub providing browse and cover
Winterfat (<i>Eurotia lanata</i>)	N,P,HS	Low shrub providing winter browse
Yellow sweet clover (<i>Melilotus officinalis</i>)	I,A/B,F	N-fixing forb providing forage and ground cover
Globe mallow (<i>Sphaeralcea</i> sp.)	N,P,F	Persistent mid-height forb providing browse
Rubber rabbitbush (<i>Chrysothamnus nauseosus</i>)	N,P,S	Mid-height shrub providing cover and erosion control
Blue flax (<i>Linum lewisii</i>)	N,P,F	Persistent forb with a pretty blue flower

^aN = Native
I = Introduced
P = Perennial
A/B = Annual or biannual
W = Warm season
C = Cool season
G = Grass
S = Shrub
HS = Half shrub
F = Forb

TABLE 4.4

BUILDING USE REGISTER

03/16/01

Chino Mines Company
New Mexico Closure Plans
M3-PN00315

AREA	TAG NO.	DESCRIPTION	Size (LxWxH)	Soil Remediation (Y/N)	Post Mine Land Use	COMMENTS
Mine Maintenance Facilities Area						
		Vehicle Maintenance	330'X185'X100	Y	Industrial	
		Wash Shop	40'X25'	Y	Demolish	
		Vehicle Maintenance	160'X40'X80'	Y	Industrial	
		Maintenance Shop	230'X150'X50'	Y	Industrial	
		Maintenance Shop				
		Electrical Maintenance	180'X60'X25'	N	Industrial	
		Storage				
		Warehouse	160'X60'X35'	N	Industrial	
		Mine Operations Office	130'X130'X15'	N	Industrial	
		Assay Lab	140'X60'X15'	N	Industrial	
		Security	40'X30'X12'	N	Industrial	
		Safety	100'X35'X12'	N	Industrial	
		Geology	60'X65'X12'	N	Industrial	
		Mine Planning/Engineering	200'X40'X15'	N	Industrial	
		Storage Shed				
		Primary Crusher	31'X22'X8'	Y	Demolish	
		Wash Shop Wastewater	80'X150'	Y	Demolish	
		Diesel Storage Tanks	2@ 300,000 gal 1@ 125,000 gal 2@ 175,000 gal	Y	Industrial	
		Assay Substation				

TABLE 4.4

BUILDING USE REGISTER

03/16/01

Chino Mines Company
New Mexico Closure Plans
M3-PN00315

AREA	TAG NO.	DESCRIPTION	Size (LxWxH)	Soil Remediation (Y/N)	Post Mine Land Use	COMMENTS
		Surface Water				
		SX/EW Plant Area				
		SX Maintenance	60'x70'x16'	Y	Industrial	
		SX Warehouse	135'x65'x16'	N	Industrial	
		Electrowinning Tankhouse	w/38'11"x102'7"x19'9" Sheet prep annex & 28'x62'7"x25' Office	N	Industrial	
		Sulfuric Acid Storage Tank	2 @ 18' D	Y	Industrial	
		Mixer Settlers	6 each 75'x80'	N	Industrial	
		Raffinate Tank		Y	Industrial	
		Tankfarm	290'x108'	N	Industrial	
		Water Treatment Building	20'x42'3"	N	Industrial	
		Pump House	20'x42'3"	N	Industrial	
		Water Tank	33'Dx29'H	N	Industrial	
		Plant Feed Pond	108'x238'	Y	Demolish	
		Raffinate Pond	110'x330'	Y	Demolish	
		Ivanhoe Concentrator/Precipitation Pant Area				
		910 Guard House & Changehouse	100x40x15', 20x17x15'	N	Keep for WTP	
		300 Ivanhoe Concentrator	384x82x90, 264x192x75', 192x28x75'	N	Keep for WTP	Salvage/Scrap SAG mills
		930 Shop & Warehouse	140x250x25'	N	Keep for WTP	
		320 SAG Mill Recycle	48x63x57'	N	Demolish	
		420 Tailing Pump House	115x60x25'	N	Keep for WTP	

TABLE 4.4

BUILDING USE REGISTER
Chino Mines Company
New Mexico Closure Plans
M3-PN00315

03/16/01

AREA	TAG NO.	DESCRIPTION	Size (LxWxH)	Soil Remediation (Y/N)	Post Mine Land Use	COMMENTS
		Electric Room	30x40x15	N	Keep for WTP	
	730	Pump House	50x80	N	Keep for WTP	
		Electric Room	40x15	N	Keep for WTP	
39	85-TK-01	Process Water Storage Tank	90'Dx60'h	N	Keep for WTP	
	84-TK-04	Fresh Water Storage Tank	40'D	N	Keep for WTP	
40		Tailing Thickeners	2@380'Dx10'H	N	Keep for WTP	
41	920	Laboratory	200x50X8"	N	Keep for WTP	
42		Cu/Moly Thickener	100'D	N	Keep for WTP	
43		Cu Thickener	100'D	N	Keep for WTP	
44	85-TK-02	Process Water Head Tank	28'D	N	Keep for WTP	
45	73-TK-02	Potable Water Storage Tank	15'D	N	Keep for WTP	
46	73-TK-05	Fire Water Storage Tank	35'D	N	Keep for WTP	
47		Electrical Building @ Coarse Ore Conveyor Drive	25x20'	N	Keep for WTP	
48	340	Pump House	12x75x30'	N	Keep for WTP	
49	410	Slurry Pump House	95x45'	N	Keep for WTP	
50	820	Reagent Mix & Storage Building	45x60x30'	N	Keep for WTP	
51		Sewage Plant	30x12'	N	Keep for WTP	
52		Frother Tanks & Pumps Area	40x80'	N	Keep for WTP	
53		NaHS Storage Tank Area	50x30'	N	Keep for WTP	
54	450	Slurry Storage Tanks	2@35'D	N	Keep for WTP	

TABLE 4.4

BUILDING USE REGISTER

03/16/01

Chino Mines Company
New Mexico Closure Plans
M3-PN00315

AREA	TAG NO.	DESCRIPTION	Size (LxWxH)	Soil Remediation (Y/N)	Post Mine Land Use	COMMENTS
		Xanthate Tanks & Pumps Area, Burner Oil Tanks & Pumps Area	50x35'	N	Keep for WTP	
		Fuel Oil Storage Tank	20'Dx15'	N	Keep for WTP	
		Fuel Oil Storage Area	70x70	N	Keep for WTP	
		Slaked Lime Tanks	2@20'D	N	Keep for WTP	
		Slaked Lime Area	45x35	N	Keep for WTP	

5. Reclamation Designs and Post-Closure Monitoring

This section presents Chino's proposed approach to reclamation and post-closure monitoring for closure/closeout of major mine facilities. The reclamation practices proposed here are intended to limit future environmental impacts and, to the extent practicable, provide protection of air and water resources consistent with state and federal laws. The reclamation plan was developed in consideration of the site-specific conditions that exist at Chino including soil, ecological, operational, and economic constraints.

Open pit mining and recovery of metals is projected to continue at the Chino Mine for many years. Since Chino is an active mine, the size and topography of the mining area is constantly changing. This dynamic nature requires the development of reclamation designs for closure/closeout that can be adapted to changing site conditions. As previously discussed by Chino, NMED, and MMD, the closure/closeout plan will be refined at 5-year intervals coincident with the renewal of the NMED discharge plans. The 5-year updates will be used to refine the closure/closeout conceptual designs to account for changes in site-specific conditions, to incorporate new technologies and, to accommodate facility changes projected in subsequent planning period. The facility characteristics and reclamation designs presented in this section are referenced to those conditions at Chino in 1998 and those projected for 2006.

The approach to designs presented in this report involves five distinct steps. First, site-specific characteristics of the major mine facilities are compiled. Second, the facilities are classified and grouped by function, site, and material characteristics. Third, performance objectives are identified for each facility group based on their characteristics and on regulatory guidance. Fourth, conceptual designs are developed and evaluated with respect to the performance objectives. Fifth, typical construction details, plans and specifications are developed for capital cost estimating purposes on a facility basis; e.g., individual tailing ponds, individual stockpiles, water treatment, etc.

The individual facility design and costing approach allows the adjustment of reclamation costs over time as the dimensions and type of mine facilities change. Final designs, technical specifications, and construction quality assurance plans for each facility will be prepared when milling, mining and SX/EW recovery of metals cease and most likely immediately before construction.

Descriptions of the facilities covered by the reclamation designs and their evaluation criteria are included in Section 5.1. The performance objectives and reclamation designs for closure/closeout of the facilities are included in Section 5.2. Water treatment methodology is outlined in Section 5.3. Section 5.4 contains post-closure monitoring and contingency plans. Finally, Section 5.5 addresses cover design. The reclamation designs and construction documents developed here are complemented by the DP Area-specific reclamation plans presented in Section 6.

In a series of letters summarized in MMD's letter of February 20, 2001, MMD and NMED have presented a number of questions and comments on studies and work plans that support this closure/closeout plan. Most of these questions have been addressed directly in the closure/closeout plan. Judgements and opinions of consultants retained by Chino as to the reasonable settlement of the remaining questions have been used to develop elements of the plan.

5.1 Facility Characteristics and Classification

Facilities have been grouped according to similarities with other individual facilities. Thus, the term "facility group" refers to discrete parts of the mine with common characteristics (e.g., tailing ponds, stockpiles); that is, the facility groups are differentiated based on functional consideration, rather than geography or regulatory boundaries. For this evaluation, tailing ponds, stockpiles, the open pit, reservoirs, and disturbed areas are identified as the major facility groups recognized at Chino. Sections 5.1.1 through 5.1.5 provide general descriptions of these major facility groups.

The characteristics of individual tailing ponds, stockpiles, the open pit, reservoirs, and other disturbed areas at Chino are summarized on facility characteristics forms (Appendix C).

5.1.1 Tailing Ponds General Description and Evaluation Criteria

Tailing is the residue remaining after the processing of milled ore. It is commonly impounded in ponds. For this copper operation, tailing is not associated with leaching. Tailing ponds at Chino are shown on Drawings Chino-01 through Chino-10, Appendix B. Table 5-1 lists the general dimensions of the tailing ponds.

Only Tailing Pond 7 is expected to change in dimensions between now and 2006. The footprint will remain fixed, but as the height increases, the relative area of the top surfaces and outslope will change. Specifically, the top surface area will decrease from 1,345 to 1,198 acres, while the outslope area will increase from 218 to 365 acres between 1998 and 2006 (based on the assumption that the elevation increases to 5,445 ft msl). Chino's long range operating plan may necessitate the construction and operation of tailing ponds designated as 8A and 8B. Construction of these ponds is currently scheduled for approximately 10 years from the date of preparation of this closure/closeout plan, well beyond the projected 2006 conditions addressed in the plan. Tailing ponds 8A and 8B will be incorporated into the plan when construction and operation fall within the projection period of a future 5-year revision to the plan. Closure/closeout activities are expected to be similar to activities discussed in this current plan for Tailing Pond 7.

In general, tailing dam out slopes have been placed at a slope flatter than 3(H):1(V). As configured, these masses are structurally sound. (Table 5-8). Slope modification of dam out slopes could create structural problems, depending upon amount of drying that has occurred within the impounded tailing and therefore may not be advisable. In general, safety factors will increase with time.

The original process water that percolates into the ground below the tailing ponds is contained with interceptor wells. Residual drainage of this process water is likely to occur for more than 30 years.

5.1.2 Stockpiles General Description and Evaluation Criteria

There are two broad classifications of stockpiles at Chino, those that are being or have been leached and those that have not been leached (Drawings Chino-11, 12, 13, 14, 22, 23, 24, and 27, Appendix B). Tables 5-2 and 5-3 summarize stockpile data.

Water that percolates into the ground and reaches the water table below the stockpiles flows either to the pit, to shallow ground water or to the regional groundwater system beyond the influence of the pit. As the pit is deepened the proportion of this water that reports to the pit will increase relative to the amount reporting to the regional groundwater system.

Flattening of the stockpiles increases their areal extent. With the increased areal extent of the stockpiles, some of the seepage will be outside the zone of capture created by the pit dewatering. Therefore, a greater percentage of the seepage that migrates into the ground beneath the stockpiles will report to the shallow and regional groundwater systems. In addition, the interceptor well containment perimeter will need to be increased. Increasing the perimeter of the containment system, by its nature, will result in the diversion of a greater volume of non-impacted water. (See Figure 5-1.)

The following data illustrates differences between the surface level capture zone for the base and alternative case:

Chino Proposed Plan (angle of repose stockpiles)

Stockpile Footprint Area Within Capture Zone = 227.9 acres

Stockpile Footprint Area Outside Capture Zone = 2779 acres

Chino Comparison Case (4(H):1(V) regrade)

Stockpile Footprint Area Within Capture Zone = 521.6 acres

Stockpile Footprint Area Outside Capture Zone = 3855 acres

5.1.3 Open Pit General Description and Evaluation Criteria

The Santa Rita pit is a single large pit with zones that are referred to as the Estrella, Lee Hill, and East Pit areas (Drawings Chino-01, 16, and 17, Appendix B). The 1998 and projected 2006 dimensions of the open pit subgroups are listed in Tables 5-4 and 5-5, respectively.

Groundwater inflows to the pit as well as impacted surface runoff must be addressed. Long-term maintenance of the pit requires a certain threshold level of water treatment. Staffing and maintenance requirements for variable treatment capacities will be largely the same. Operating costs for reagents and power will vary.

5.1.4 Reservoirs/Dams

Over 20 named reservoirs and dams are in existence at Chino (Drawings Chino-02 and 21, Appendix B). These facilities are differentiated on a functional basis between detention and retention structures. The detention structures intercept surface water, seeps, or perched water and direct flows to permanent impoundment or treatment facilities. The retention structures impound process and/or stormwater, including the water intercepted in the detention structures. Some of these facilities have post-closure functions, such as differential transfer of impacted versus non-impacted water. The type, location, post-closure function, and dimensions for the reservoir/dam subgroups are summarized in Table 5-6. No new reservoir/dam facilities are currently projected in the 5-year plan; however, future permitting may necessitate the installation of additional containment structures. The CCP will be updated, as necessary, to describe reclamation techniques for future reservoirs/dams.

5.1.5 Disturbed Areas

A miscellaneous group of disturbed areas such as haul roads, operational roads, existing borrow areas, and pipeline and utility corridors were identified at Chino. The locations and dimensions of such disturbed areas are listed in Table 5-7.

5.1.6 System Dynamics of Water Issues and Evaluation Criteria

For the purpose of assessing impacts to surface and groundwater, the Chino mine site can be categorized into the three following areas:

- Mine Pit Hydraulic Sink (self-forming or maintained by pumped drawdown) – Includes Stockpile Percolation Within Capture Zones

- Stockpile Percolation Outside Capture Zones and Other Disturbed Areas
- Distal Tailing Disposal Facilities

Figure 5-1 is a conceptual illustration of the designated mine system divisions. The pit hydraulic sink is maintained through evaporation and pumping. The pumping of inflows from the Santa Rita Pit forms a very large hydraulic sink that encompasses all sub pits. Some of the seepage from the stockpiles is also captured by this hydraulic sink..

Outlying stockpiles and disturbed areas fall outside of the groundwater capture zone created by the pit (Figure 5-1). An example is the South Stockpile.

Distal Tailing Facilities are located beyond any influence of the groundwater capture zone created by the pit.

Each of the three areas has unique groundwater, surface water, erosion controls, materials characterization, and seepage quality and quantity sub-system dynamics that call for analysis of the specific technical work that has been conducted in those areas. For example, the pit lake water quality predictions are based on the groundwater flow and pit lake formation and geochemical studies and modeling efforts. The predictions of water quality in the Outlying Stockpile Areas and Distal Tailing Facilities models are based on materials characterization, and seepage quality and quantity studies and modeling. Because of the physical and chemical differences between the stockpile and tailing, the technical discussions are broken out accordingly.

5.2 Complying with Performance Objectives/Reclamation Design

Performance objectives were developed in accordance with regulations and specific requests from the NMED and MMD. This section presents reclamation designs in accordance with such objectives. The designs are developed in sufficient detail to:

- a) demonstrate a compliant plan, and
- b) facilitate the preparation of a cost estimate for the plan

Final construction drawings, technical specifications, and construction quality assurance plans for each facility will be prepared, as necessary, prior to the end of mining and metals recovery.

5.2.1 Tailing Ponds

The performance objectives for the top surfaces and outslopes of the tailing ponds are establishment of a self-sustaining ecosystem, control of fugitive dust, control of runoff and erosion, prevention of overtopping, and the reduction of ponding and infiltration. The major performance objectives associated with the tailing pond toe and hillslope perimeters are maintenance of regional groundwater quality and prevention of undercutting erosion from channel flow, subsurface inflow, and runoff. The following subsections describe the conceptual-level designs for the reclamation of the tailing ponds.

Lists of the major reference documents used in the development of these designs can be found in Appendix E (Borrow Materials and Cover Design), Appendix F (Structural Stability), Appendix G (Water Issues), Appendix H (Tailing Ponds), and Appendix L (Erosion Calculations).

5.2.1.1 Structural Stability of Tailing Dams

The gross stability of the tailing dams with respect to mass failure has been determined to be adequate; i.e., conservatively calculated Factors of Safety are greater than 1.1 (Table 5-8). Tailing dams will remain stable under post-closure conditions. In general, these mass structures become more stable with the long term lowering of the phreatic water surface.

5.2.1.2 Tailing Pond Erosion and Drainage Control

The potential for tailing dam undercutting has been negated by past diversion projects.

Drainage and erosion control for tailing ponds will be achieved by providing berms, stormwater conveyance mechanisms (i.e., sheet drainage and/or directed flow in rock lined ditches and ravines), stable slope configurations, revegetation, and where appropriate, slope cover armoring. In general, rock lined channels are preferred to isolated culverts or concrete structures used in concert with earth channels (Drawings Chino-07, 08 09, 10, and 15, Appendix B). Some State personnel have indicated a preference for the alternate of conduits; others have indicated a preference for open ditches. In general, runoff is carried by channels rather than conduits (i.e., culverts or pipes) in this plan. Conduits will only be employed as required to prevent commingling of impacted water and non-impacted water; e.g., such as streams crossing each other.

Most of the tailing ponds have been constructed completely above grade, and runoff is not expected to be a post-closure concern. Specific exceptions are discussed in Section 6.

The tailing pond top surfaces slope approximately 0.5%. Final grade construction of 0.5% to 5% will direct water to dedicated rock aprons at the entrance to ravines and/or spillways. As an additional element incorporated into the cost of this plan, rock protected apron entrances have been employed (Drawing Chino-04, Appendix B). These will slow runoff velocity plus relocate area of possible erosion away from face of ponds. Spillways and ravines will be designed to convey stormwater from the top surfaces, while perimeter berms will protect the general outslopes. During final design, sheet drainage velocities will be confirmed and local conditions adjusted if and as required. For example, smaller pond top surfaces might not need rock armoring, and this allowance could be used for any critical areas of larger dams.

The roughness of the top surface will be constructed within ± 2 inches. Roughness is defined as depth of small pockets and puddles that will develop because of construction techniques and top surface particle size. In the event of light precipitation, most water will either evaporate or transpire.

Modest contouring (mounding) of dam faces may occur as structural stability permits; i.e., based on test results during detail engineering.

Except for small isolated segments, the tailing pond outslopes generally have gradients flatter than 3(H):1(V). Where appropriate, water control on the outslopes will be attained using ravines and/or slope breaks. Rock armoring or shielding (an allowance has been made for 30 percent cover of +2 to -5 inch diameter fragments in upper 6 inches or 50% cover of the upper 3.5 inches; i.e., mean diameter of rock) will be placed over the soil cover on the tailing pond outslopes to reduce soil loss rates. Vertical distance between benches will be limited to 100 feet to better manage erosion. Of significance is the fact that the need for rock armoring is less for flatter slopes, shorter slopes, and the upper reaches of long slopes. For example, RUSLE theory indicates that 20% rock armoring is sufficient for much of the faces. A 30% value is required to keep erosion to under three tons per year at the bottom of the slopes. Final construction drawings will clearly differentiate concentration of shielding required.

Gabion spillways will be constructed with PVC-coated wire for the boxes and mattresses. Filter fabric will be placed beneath the Gabion mattresses of the spillway chute. During final design, spillway velocities will be confirmed and slopes adjusted if required.

Short-term erosion control measures may be needed during the construction and early vegetation establishment periods. These measures include, but are not limited to, divoting with a dozer blade, mulching, use of straw bales and silt fences, and minor regrading. Divoting with dozer blades will be used as a short-term erosion control methodology for covered slopes (Drawing Chino-25, Appendix B). Except for mulching, these practices will be applied on an as-needed basis in the final design or post-construction phases. The existing sediment detention ponds will be used to control sedimentation of off-site areas during the vegetation establishment period.

During final design, outlet channel velocities will be calculated and energy dissipaters placed as required. It is noted that it is common practice for municipalities to solicit and use mine rock for erosion control and dissipation measures for municipal channels.

5.2.1.3 Tailing Pond Cover and Revegetation

Significant quantities of soils and topdressing exist in the South Mine Area near the tailing ponds. The characteristics of the potential borrow materials vary and thus provide a range of opportunities for cover applications. Covers on the order of 12 inches thick appear to be sufficient to reduce infiltration, protect the tailing from osion, and support appropriate plant life.

Thicknesses included in the closure/closeout plan have been conservatively designed as:

	Proposed Plan	Comparison Case
Top Cover	18"	36"
Average Slope Cover	24"	36"

For top cover, a construction tolerance has been specified at -2 inch, $+4$ inch. So, for example, a nominal 18 inch thick top cover would more likely have an average thickness of 19 inches. For slope cover, construction tolerance has been specified at ± 4 inch, so, a 24 inch specified thickness is likely to have an average of 24 inches.

The relatively thinner covers on the top surfaces in the base case are justified by the low flux density associated with the finer-textured tailing that comprises the interiors of the ponds. A thicker cover is currently proposed for the outslopes to account for the increased erosion potential.

A large portion of the tailing surfaces at Chino have been capped with local soils to control fugitive dust, but minor regrading may be required. Bulldozers, motor graders, or equivalent equipment will be used to smooth the surfaces and facilitate access for supplemental cover placement and seeding. Where applied, this treatment will result in a roughened surface that will enhance interlocking of the cover material with the tailing.

Revegetation will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs. The proposed seed mix for the South Mine Area tailing ponds is summarized in Section 4. The seed will be applied using an appropriate technology (e.g., drill or broadcast) depending on the cover and site characteristics. The current proposal involves broadcast seeding into a roughened seedbed. Seed coverage will be accomplished using a chain or tire drag. Straw or native grass mulch will be applied at a rate of about 2 tons per acre and stabilized by crimping or applying a tackifier emulsion. The mulch will be reasonably weedfree and will contain a minimum of viable seeds associated with the mulch source (e.g., barley or wheat). Long-stem mulch will be given preference over shorter materials.

5.2.1.4 Tailing Pond Groundwater Containment

Impacted groundwater, including any tailing decant waters, will be contained using down gradient interceptor well systems (e.g., wells, sumps, and pumps) similar to those currently operating immediately south and southwest of Tailing Pond 7. The interceptor systems will be operated during the post-closure period in a manner similar to current operation. Water quality will be monitored to differentiate impacted from non-impacted water. Impacted water will be commingled with treated water and non-impacted water to produce a discharge that is suitable for discharge to a beneficial use such as crop irrigation.

5.2.2 Stockpiles

The performance objectives for closure/closeout of the stockpile facility subgroups are establishment of a self-sustaining ecosystem, reduction of infiltration, containment seeps and sediment, and the control of runoff, runoff, and releases to perched and regional groundwater aquifers.

Lists of the major reference documents used in the development of conceptual-level designs for the reclamation of stockpiles can be found in Appendix E (Borrow Materials and Cover Design), Appendix F (Structural Stability), Appendix G (Water Issues), and Appendix I (Stockpiles).

5.2.2.1 Structural Stability

The gross stability of the stockpiles has been determined to be adequate (see Appendix F). They will remain stable under post-closure conditions. (Table 5-9.)

5.2.2.2 Stockpile Erosion and Drainage Control

The stockpiles are susceptible primarily to erosion processes associated with concentrated flow (Drawings Chino-11, 12, 13, 14, 15, 16, and 17, Appendix B).. In general, drainage and erosion control for the stockpiles will be achieved by providing berms, mechanisms for stormwater conveyance, stable slope configurations, revegetation, and sediment containment structures.

Stockpile top surfaces have been (or will be) graded to 1% to 5% slopes to promote proper drainage.

The roughness of the top surface will be constructed within ± 2 inches. Roughness is defined as depth of small pockets and puddles that will develop because of construction techniques and top surface particle size. In the event of light precipitation, most water will either evaporate or evapotranspire.

Stockpile top surfaces will be graded to direct non-impacted water to designated discharge areas. Dedicated or designed rock lined channels will be used to mitigate erosion. If needed, these features will be designed to minimize channel gradients to reduce flow velocities. The reduced flow velocities will decrease the potential for channel incision, bank destabilization, and sediment transport. To promote the long-term integrity of the structures,

construction of these channels will incorporate existing topography, grade controls, and exposed inert bedrock where possible. The existing berms on the stockpile top perimeters will be upgraded, where necessary, and maintained to prevent the concentration of flow onto the out slopes.

Most of the stockpiles have been constructed completely above grade, and runoff is therefore not an issue. However, the Southwest Lampbright stockpile has a hillslope perimeter on the west side where it abuts the natural topography. Runoff controls will be designed and constructed in the appropriate areas prior to the closure/closeout of the facilities.

The existing stockpile out slopes at Chino are composed of clast-dominated run-of-mine rock in various stages of weathering and are typically at angle of repose. Drainage and sediment detention structures and/or perched zone interception systems are located as required to control sedimentation and groundwater impacts.

Non-impacted top surface water will report to discharge area via the existing stockpile access roads with enhanced ditches.

Short-term erosion control measures may be needed during the construction and early vegetation establishment periods. These measures include, but are not limited to, mulching, use of straw bales and silt fences, and minor regrading. Divotting with dozer blades may be used as a short-term erosion control methodology for cover slopes (Drawing Chino-25, Appendix B). Except for mulching, these practices will be applied on an as-needed basis in the final design or post-construction phases. The existing stormwater reservoir/dam system will be used to control off-site sedimentation. All construction will be in compliance with state regulations for temporary storm water control.

During final design, outlet channel velocities will be recalculated and energy dissipaters will be placed as required.

5.2.2.3 Stockpile Cover and Revegetation

The best available topdressing resource in the North Mine Area is stockpiled overburden composed of Kneeling Nun Rhyolite and Sugarlump Tuff. Current mining projections indicate that about 50 million yd³ of these rock units will be available for use as topdressing. At Chino, the Kneeling Nun Rhyolite and Sugarlump Tuff are mined and stockpiled separately from the sulfide-bearing ore and waste rock. These materials have no apparent chemical limitations associated with sodicity, salinity, or acid generation. However, their use may be limited by high

rock fragment content and lower water retention capacities (i.e., as compared to Gila Conglomerate).

The effectiveness of the Kneeling Nun Rhyolite and Sugarlump Tuff as cover materials to reduce water entry into the stockpiles has been investigated. The long-term effectiveness of these materials to support a self-sustaining ecosystem could be demonstrated through initial reclamation test plots.

Cover thicknesses included in the closure/closeout plan have been conservatively designed as:

	Proposed Plan	Comparison Case
Top Surface Cover	24"	36"
Average Outslope Cover	No cover	36"
Slope (overall)	Angle of repose	4(H):1(V)

Ongoing regrading and ripping during the operating period will result in planar top surfaces with minor irregularities. Thus, only minor regrading is expected to be needed to facilitate cover placement and/or stormwater removal. Haul roads and other severely compacted areas will be ripped on an as-needed basis. Where possible, the regrading and ripping of compacted areas will be accomplished during near-closure operational phases.

Revegetation of the top surfaces will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs. The proposed seed mix for the North Mine Area stockpiles is discussed in Section 4. The seed will be applied using an appropriate technology (e.g., drill or broadcast) depending on the cover and site characteristics.

The current proposal involves broadcast seeding into a roughened seedbed. Seed coverage will be accomplished using a chain or tire drag. Straw or native grass mulch will be applied at a rate of about 2 tons per acre and stabilized by crimping or applying an emulsion tackifier. The mulch will be reasonably weed-free and will contain a minimum of viable seeds associated with the mulch source (e.g., barley or wheat). Long-stem mulch will be used when possible.

Section 5.5 presents a detailed scientific discussion on cover design.

5.2.2.4 Stockpile Surface Water, Groundwater, and Sediment Containment

The existing and planned reservoirs, dams, berms, sumps, collector pipes, and pumpback systems will be integrated into a new overall system to control releases to surface water, perched water, and groundwater.

New interceptor well and structures for water direction transfer will be required.

For both the base case and alternate case, some sort of water treatment will be needed to meet New Mexico WQQC standards. Following the initial volume reduction of the process waters by evaporation and establishment of a soil cover and vigorous reclaimed plant communities passive bio-remediation water treatment systems may be used to replace active chemical systems at many of the facilities. Research is advancing this field considerably.

5.2.2.5 Outslope Considerations

Three main cases have been considered:

- a) Angle of repose uncovered out slopes
- b) 4(H):1(V) pushdown overall (i.e., 3(H):1(V) slopes plus benches) with covered out slopes
- c) 3(H):1(V) pullback overall with covered out slopes

Case b) requires double the construction resources of case a). Case c) requires double the resources of case b) in addition to significantly increasing remaining mining costs.

5.2.3 Open Pit

5.2.3.1 Pit Waiver and Protection

The performance objectives for the open pit facility subgroups are centered on runoff control, safety, operational access, and groundwater control. Chino is applying for a waiver from the requirements of achieving a PMLU or SSE for the Santa Rita pit. The closure design for the open pit that follows is predicated on the assumption that a waiver will be granted by the MMD.

The performance objectives for the pit crest perimeter are to control runoff and uncontrolled access to protect public safety. Placing a water diversion and vehicle exclusion berm around the circumference of the Santa Rita pit will achieve these goals (Drawing Chino-19, Appendix B). The proposed berm will be 10 feet high 1.5(H):1(V) sideslopes. The berm will be constructed of local rock and soils rather than of imported borrow materials. In addition to controlling runoff, this berm will improve safety by limiting vehicle access. Site-wide access control will be provided at the mine property line by new and existing fences and security staff.

The performance objective for the open pit sideslopes is to capture non-impacted water flows resulting from direct precipitation above the oxide/sulfide mineralization interface and to maintain access for operation and maintenance (Drawings Chino-17, 18, 21, 22, 23, and 24, Appendix B).

Pit walls are designed to ravel and they are thought to be sufficiently stable that a specific conceptual design alternative is not needed. Any materials that erode or tumble off these slopes will be contained within the pit.

The performance objectives for the pit floor are to provide a groundwater sink and to capture and remove impacted water. Impacted water will be captured in pit floor sumps then removed to the site-wide water treatment facility.

Data for the past ten years indicates that an average pumping rate of less than 500 gpm was required to maintain steady state conditions; i.e., to offset precipitation and groundwater inflow.

This rate may decrease with the diversion of non-impacted water at upper levels in the pit (Drawing Chino-20, Appendix B).

A potentially viable future (say after 30 years of water treatment operation) alternative to capture and pumping is the creation of a pit lake. Without pumping, the Santa Rita pit will partially fill with water, forming a lake, and act as a perpetual groundwater sink after closure. Eventually a state of equilibrium will occur at the level where pit water and groundwater pressures equalize. The high evaporative losses associated with the pit lake would result in a positive hydraulic gradient toward the pit for the foreseeable future, thereby protecting the local groundwater resources. This option has not been considered in financial assurance estimates.

Lists of the major reference documents used in the development of conceptual-level designs for the closeout of the Santa Rita Pit can be found in Appendix G (Water Issues), and Appendix J (Mine Pits).

5.2.3.2 Alternatives Considered

- a) Pit waiver to leave as dry pit in near future after closure
- b) Backfilling pit to grade level with surface drainage system provided
- c) Slope pullback to 3(H):1(V)
- d) Slope pushdown to 3(H):1(V)

Alternate Case a) by far uses the least resources. Alternate Case b) raises water quality issues. Alternate Case c) with blasted rock requirements is excessive and potentially unsafe to construction workers. Alternate Case d) with blasted rock requirements is excessive, potentially unsafe to construction workers, and raises water issues.

5.2.4 Reservoirs/Dams

5.2.4.1 Units Available for Temporary or Permanent Water Handling

On a broad scale, the performance objectives for these facilities are to retain or convey process, decant, and surface water. In general, the reservoir and dam facilities will likely be the last features to be closed following the establishment of vegetation and site stabilization. However, in some instances they may become permanent parts of the reclaimed landscape and will be maintained throughout the post-closure period. The disposition of specific facilities with respect to closure/closeout is detailed in Section 6.

Reclamation of the structures that will be closed will involve grading to achieve positive drainage followed by revegetation. The specific seed mix will be determined by site-specific factors, but will generally follow the North Mine Area and South Mine Area geographic distinctions. A minimum of 18 inches of suitable cover materials will be provided in the proposed plan in the areas to be reclaimed. Any existing non-deleterious, non-compacted rooting material can be used as part of this final thickness. Costs are estimated for all new material. In the comparison case, 36 inches of cover will be provided. Some retention structures may remain if they serve PMLU functions.

Most of the detention or conveyance structures are associated with the stockpile toe perimeter control systems and will be maintained throughout the post-closure period.

Lists of the major reference documents used in the development of conceptual-level designs for the closeout of reservoirs and dams can be found in Appendix E (Borrow Materials and Cover Design), and Appendix K (Reservoirs and Disturbed Areas).

5.2.5 Disturbed Areas

Performance objectives for disturbed areas include creation of a self-sustaining ecosystem and erosion control.

Lists of the major reference documents used in the development of conceptual-level designs for the closeout of borrow areas can be found in Appendix E (Borrow Materials and Cover Design), and Appendix K (Reservoirs and Disturbed Areas).

5.2.5.1 Demolition and Salvaging

Reclamation of the disturbed areas will be accomplished by removing or burying utility and structure foundations (e.g., nonfunctional pipelines, power lines, buildings) and providing erosion and drainage control and revegetation. The necessity for removing utility structures will be determined on a site-specific basis. Buildings will be demolished or converted to an alternative industrial use per Table 5-7. The erosion and drainage control practices will include rough grading and installation of water bars, minor diversions, sediment containment structures, mulching, straw bales, and silt fences. The need for these features will be developed on a site-specific basis at closure. The sites will be ripped and covered (18 inch thick cover for the proposed plan and 36 inch thick cover for the comparison case) where existing surface materials are deemed not suitable. Any non-deleterious, non-compacted rooting material can be used as part of this final thickness. Costs are estimated for all new material.

Finally, depending on the geographic location, the sites will be seeded using either the North or South Mine Area seed mixes.

5.2.6 Borrow Areas

Table 5-10 summarizes available borrow areas. Section 5.5 contains scientific discussion of the various materials.

For the North Mine Area, the topdressing borrow areas proposed in this closure/closeout plan are the Northwest Stockpile and the Upper South portion of the South Stockpile. The Northwest Stockpile will be depleted and so will have the performance objectives associated with Disturbed Areas (Section 5.2.6). The Upper South Stockpile will be partially consumed and so will have the performance objectives associated with stockpiles (Section 5.2.2).

For the South Mine Area, the topdressing borrow area proposed in this plan is a new borrow pit outside the western boundary of DP-214. Performance objectives for the borrow pit include the establishment of a self-sustaining ecosystem and control of erosion. This pit may be incorporated in the post-mining water management system to provide stormwater control.

5.2.6.1 Soil Testing

With ongoing construction, soil sampling and testing will be carried out as required to verify the suitability of the various soil parameters. Presently any sampling is limited to surface pits. Reclamation of the borrow "hills" will occur with the excavation operation. Such sampling and testing is covered in the Construction Management Costs of the Capital Cost Estimate.

5.2.6.2 Reclamation Design

Chino Mines will continue to segregate similar materials as part of its mining operations.

The Northwest Stockpile remnants will be reclaimed using methods similar to those described for the disturbed areas with the exception that no cover will be imported.

The Upper South Stockpile which will be only partially consumed will be reclaimed using methods similar to those described for stockpiles with the exception that no cover material will be imported and placed. Where compacted, the borrow material stockpile top surface will be ripped to a depth of approximately 24 inches.

The topdressing borrow pit in the South Mine Area will have moderate side slopes as a result of the specified excavation plan. Practices for excavation and reclaim will be similar to that employed by various state highway departments. The areas will remain free draining by surface runoff.

Borrow pit side slopes and bottom will be ripped where required and revegetated with the seed mix recommended for the South Mine Area.

5.2.6.3 Soil Salvaging

Chino Mines will salvage all suitable topsoils and topdressing that is practically feasible as mining expands into undisturbed areas.

5.3 Water Management and Treatment

5.3.1 Performance Objectives

The primary performance objectives for water management and would be to insure that the water quality is appropriate and meets applicable NMWQCC standards for the anticipated beneficial use or discharge.

5.3.2 Closure/Closeout Plan Objectives

In pursuit of performance objectives, plan elements have been selected to segregate impacted and non-impacted waters as close to the source as possible, release compliant waters to approved points of discharge, and treat impacted water to meet NMWQCC water quality standards (Title 20, Chapter 6, Part 2, Subpart III, Section 3103, Standards for Groundwater of 10,000 mg/L TDS concentrations or less), prior to beneficial use.

5.3.2.1 Segregation

Discrete water streams which will result from elements of the closure/closeout plans for major mining components (tailing ponds, stockpiles, and the Santa Rita pit) are identified as:

For tailing ponds:

- runoff diversion at hillslope perimeters
- controlled top surface cover runoff
- outslope erosion control channel runoff
- seeps and basal flows, if present, captured by toe drains and/or pump-back wells
- interceptor well water

For stockpiles:

- runoff diversion at hillslope perimeters
- controlled top surface cover runoff
- outslope erosion control channel runoff
- seeps and basal flows, if present, captured by toe drains and/or pump-back wells
- interceptor well water

For the Santa Rita pit:

- perimeter berm runoff diversion
- direct precipitation above the oxide/sulfide mineralization interface captured by channels and sumps located on the pit wall
- direct precipitation, seeps and stockpile outslope flows captured by pit floor sumps

5.3.2.2 Management Zones

For this closure/closeout plan water management at Chino has been subdivided into three zones. Two zones in the North Mine Area are differentiated by the limit of the perpetual sink caused by net evaporation conditions in the Santa Rita pit. A third zone recognizes the geographic separation (four miles) of the North and South Mine Areas. The Santa Rita pit and leach and waste rock stockpiles are located in the two North Mine Area zones while tailing ponds occupy a part of the South Mine Area. In subsequent discussion in this section, these zones are referred to as:

- North Mine Area, inside the pit sink cone of influence
- North Mine Area, outside the pit sink cone of influence
- South Mine Area

5.3.2.3 Sources of Non-Impacted Water

The following water sources are not expected to be impacted because water will not contact leach and waste stockpile material or with tailing.

North Mine Area inside the pit sink cone:

- diverted runoff at stockpile hillslope perimeters
- stockpile top surface runoff

North Mine Area outside the pit sink cone:

- diverted runoff at stockpile hillslope perimeters
- stockpiles top surface runoffs
- stockpile outslope erosion control channel runoff (comparison case)

South Mine Area:

- diverted runoff at tailing pond hillslope perimeters
- tailing pond top surface runoff
- tailing pond outslope erosion control channel runoff
- tailing pond interceptor well water
- Whitewater Creek infiltration gallery water
- Make-up water wells

5.3.2.4 Sources of Potentially Impacted Water

North Mine Area inside the pit sink cone:

- direct precipitation above the oxide/sulfide mineralization interface in the Santa Rita pit

North Mine Area outside the pit sink cone:

- stockpile outslope runoff (proposed plan)

South Mine Area:

- none

5.3.2.5 Sources of Impacted Water

North Mine Area inside the pit sink cone:

- stockpile outslope runoff

- stockpile seeps and direct precipitation falling below the oxide/sulfide mineralization interface (both collected in pit floor sumps)

North Mine Area outside the pit sink cone:

- stockpile seeps and basal flow collected by toe drains and/or pump-back wells
- stockpile interceptor wells

South Mine Area:

- tailing pond seeps and basal flow, if present, captured by toe drains and/or pump-back wells
- tailing decant solution

5.3.2.6 Cobre Mining Company Impacted Waters

Cobre Mining Company operates a copper mine and mill facility located 3 miles north of the Chino Mine. The Cobre facility includes an open pit, a proposed leach stockpile, concentrators, a tailing pond and waste rock stockpiles. The closure/closeout plan for the Cobre Mine includes the transport of 200 gpm of impacted water to the Chino water treatment facility.

5.3.2.7 Disposition of Non-Impacted Waters

Most non-impacted waters will be discharged at approved discharge points near the source of flow. Tailing pond interceptor well water, Whitewater Creek infiltration gallery water and South Mine Area make-up well water commingled with water treatment plant effluent to produce water suitable for beneficial use.

5.3.2.8 Disposition of Potentially Impacted Waters

Potentially impacted water will be detained in ponds until quality measurement is completed then discharged to approved discharge points (non-impacted water) or transported to the water treatment plant. The water treatment plant will be preceded by an surge/mixing reservoir in order to moderate varying feed volumes and qualities. The water treatment plant will be capable of handling a range of flow rates and feed qualities.

5.3.2.9 Disposition of Impacted Waters

All impacted water will be transported to the water treatment plant feed reservoir for subsequent treatment in the water treatment plant. Water treatment plant effluent will be commingled with tailing interceptor well water, Whitewater Creek infiltration gallery water and South Mine Area make-up well water.

5.3.3 Water Treatment Plant

5.3.3.1 Performance Objectives

A conceptual plan for post-closure water treatment has been prepared for Chino by SRK Consulting (SRK) (Appendix G). In developing the plan, alternative treatment technologies were reviewed for:

- ability to treat the quantity and quality of water anticipated at mine closure
- ability to meet New Mexico water quality standards by reducing water contaminant concentration, volume and mobility
- technical feasibility
- economic reasonableness

The SRK plan provides a review of post-closure water treatment and water management alternatives, and a detailed discussion of the selected alternatives.

SRK reviewed the most recent water quality data, current water quantities from Chino and Cobre, and reports previously prepared for both properties. The water quantity information was obtained from: analytical samples collected in accordance with Chino's various discharge plans, operational knowledge, the Northern Area Groundwater Flow Model (Woodward-Clyde, 1998), Long-Term Post-Mining Pit Lake Water Quality Santa Rita Pit (URS Greiner Woodward Clyde, 1999) and General Hydrology and Water Balance Models for the Proposed Continental Mien Expansion Project (Shepherd Mill, 1999).

Using the above information, SRK performed a preliminary review of water treatment options. These included: filtration, precipitation, reduction, and evaporation treatment technologies. SRK also considered potential beneficial uses for treated water including: release to Whitewater Creek, re-injection to recharge

the aquifer, provision of a drinking water supply, creation of a recreational lake within the pit, creation of a wetlands with release to the creek, or agricultural use.

Based on the above, a water management philosophy that includes treating water when necessary to allow for beneficial use of the effluent water.

In the proposed conceptual plan, post closure water generated at Chino and Cobre will be treated to meet NMWQCC water quality standards found in Title 20, Chapter 6, Part 2, Subpart III, Section 3103 Standards for Ground Water of 10,000 mg/L TDS concentrations or less.

A discussion of the options reviewed for SRK's conceptual water treatment plan, along with detail of the preferred treatment methods is presented in the following section.

5.3.3.2 Water Treatment Plant Influent

The average anticipated flow rates from the various sources discussed in Section 5.3.2 above are:

		Proposed Plan Design	Comparison Case Design
Pit In-Flow Water	<u>Theoretical</u> 400 gpm	400 gpm	500 gpm
Pit Storm Water	300 gpm peak		
(seasonal)	100 gpm avg	300 gpm	300 gpm
Stockpile Runoff	300 gpm peak		
(seasonal)	1,000 gpm avg	300 gpm	100 gpm
Stockpile Seeps	<u>200 gpm</u>	<u>300 gpm</u>	<u>400 gpm</u>
Totals	800 gpm avg	1,300 gpm	1,300 gpm

A value of 500 gpm has been assigned to Pit In-Flow Water in the comparison case versus the 400 gpm for the proposed plan to accommodate uncertainties associated with the larger stockpile outcrops area.

Design values rather than theoretical values have been used to size water treatment facilities to compensate for surges and modeling inaccuracies. In addition, 200 gpm of water from the Cobre mine is presumed to report to this plant. For capital cost estimating purposes, a 1,500 gpm plant has been assumed. For operating costs, a 1,000 gpm plant has been estimated for the initial 5 years of operation. After 5 years, the treatment rate is expected to diminish to 800 gpm and after 20 years to 600 gpm (Table 5-11).

Aluminum concentrations are expected to decline from 2,000 mg/L (first 5 years) to 1,000 mg/L (second 5 years) to 300 mg/L thereafter. Operating cost estimates reflect these reductions.

Table 5-12 provides expected influent water quality and treatment objectives.

5.3.3.3 Water Treatment Options

Potential water treatment options for post-closure water at Chino include: no treatment, lime precipitation, nanofiltration, reverse osmosis, ion exchange, sulfide precipitation of metals, ettringite precipitation of sulfate, biological sulfate reduction, evaporation (including natural evaporation, enhanced evaporation with spray equipment and evaporator/crystallizers), and infiltration/underground injection.

- Impacted water does not currently meet State of New Mexico water quality standards; therefore, the no treatment alternative was not considered.
- Lime precipitation is commonly used where large flows and low pHs are involved. Lime treatment can be effective at neutralizing low pH water and reducing most metals to below drinking water standards. Although lime treatment alone will not reduce sulfate concentrations to below about 1,500 to 2,000 mg/L, this concentration of sulfate is not expected to present a problem at the current site. Based upon an evaluation of the factors listed above, lime precipitation was selected as the treatment option to be analyzed in greater detail.
- Lime sludge, generated through the lime precipitation process, may be processed for metals recovery. However, if metals recovery is desired, reduced sulfur compounds can be used before lime treatment to produce metal sulfides that may be better suited for a particular recovery process. Metal sulfide precipitation was not considered further in this conceptual plan.
- Processes for sulfate removal include ettringite (calcium aluminum sulfate/hydroxide) precipitation, often used in conjunction with lime treatment, and nanofiltration. Either of these processes may be able to remove sulfate to below 250 mg/L in particular applications. However, since low concentrations of sulfate were not required at this site, additional sulfate removal (beyond lime treatment) was not considered in detail.
- Evaporation (natural, enhanced, or evaporator/crystallizers) may be the best option for very high TDS water (>100,000

mg/L). The resulting salts may be suitable for processing for metals recovery in some cases. However, only limited amounts of high TDS water is expected to be present at the site, with most of the water to be treated containing much lower TDS values therefore evaporation was not considered in greater detail.

- Reverse osmosis (RO) can be used if TDS is below about 50,000 ppm. RO produces permeate (treated) water and reject (brine) water; therefore, the use of RO would require disposal of the reject water, perhaps by evaporation. Water softening using chemical treatment and/or ion exchange may also be required to reduce calcium and magnesium hardness prior to reverse osmosis treatment.

Overall recovery of water for a single pass RO system at the site is expected to be about 60 to 70 percent, depending on water constituents and system design. Therefore, a significant percent of the influent water would require disposal through evaporation, or other means. Also, costs associated with RO treatment are generally much higher than those required for lime treatment; therefore RO was not considered in greater detail.

- Ion exchange can be used to remove metals and anions, but waste brine from resin regeneration would require disposal. Ion exchange is generally used on water with relatively low TDS concentrations (< about 2,000 ppm). Since the water requiring treatment at the Chino site contains significantly higher TDS levels, ion exchange was not considered in greater detail.
- Biological sulfate reduction can remove metals as sulfides. A carbon source, such as methanol, is required for biological growth. Both passive and active systems can be designed. Relatively large areas are required for biological processes, and treatment objectives may not be met for all constituents. Therefore, biological sulfate removal was not considered in greater detail.

Based on analyses of potential treatment options briefly discussed above, expected influent water quality, and treatment objectives, lime precipitation was chosen as the most feasible treatment option for this site. Lime precipitation options are discussed below.

5.3.3.4 Lime Precipitation Treatment Options

The aluminum concentrations in the influent water is an important criterion for design of a lime precipitation water treatment process. Analyses for aluminum is only required by Discharge Plan 493 (DP-493); therefore, limited data was available. The most recent analytical results for aluminum varied from <0.02 mg/L to ~4700 mg/L. Based upon this large variation in results, two concentrations of aluminum in the influent were considered: 2,000 mg/L and 3,000 mg/L.

In addition to two aluminum concentrations, two lime treatment schemes were evaluated: a Densadeg reactor/clarifier system, patented by Infilco Degremont Inc., and a high density sludge (HDS) lime treatment process, patented by USFilter. The HDS process was selected for the proposed plan.

5.3.3.5 Lime Precipitation using the HDS Process

The high-density sludge (HDS) process is patented by USFilter, and involves recirculation of a portion of the sludge removed from a conventional clarifier. The process would involve the use of the conventional clarifier; with associated rapid mix tank and reactor, in a single-stage process. The set point for the single-stage precipitation process would be a pH of about 9.5.

In the HDS process, a portion of the clarifier underflow sludge would be recycled to the rapid mix tank to aid in sludge formation and densification. This would produce a high density sludge; expected to be approximately 30% solids or greater, according to information provided by USFilter. A process flowsheet is provided on Drawing Chino-17 and a proposed plant location is shown on Drawing Chino-29.

Sludge from the clarifier could be filtered through two or alternatively or three filter presses (plate and frame or belt), depending on the aluminum concentration of the influent water, as discussed above. Filter cake is expected to be about 60% solids, based on information provided by USFilter. Specific sludge and filter cake characteristics could be determined through bench scale tests of representative influent water.

The amount of sludge to be generated from lime precipitation was estimated to be about 100 tons per day on a dry weight basis, at a flow rate of 1,000 gpm. At 25% solids content, approximately 400 tons per day of sludge is expected. If 35% solids were obtained from the clarifier underflow, approximately

285 tons of sludge would require disposal daily, at a flowrate of 1,000 gpm.

5.3.4 Beneficial Use of Effluents

Effluent water from the water treatment facility and water from the Whitewater Creek interceptor well system, will be transported to the South Mine Area via the existing tailing pipeline. The water will then be commingled with water from tailing interceptor wells and make-up water wells through a series of holding tanks and manifolds. Resulting water quality will be suitable for several beneficial uses including re-injection to the regional aquifer, drinking water, or agricultural use.

5.4 Bioremediation (far term closure)

Long term bioremediation has the advantage of being more passive (less intrusive) and potentially utilizing less non-renewable resources. Bioremediation is not part of the proposed closure/closeout plan but the process could become the proposed treatment method in future updates of the closure/closeout plan.

There are two modes of biological treatment, in-situ and in treatment tanks. In-situ may be either in a stream bed planted with salt tolerant plants or in a subterranean flowing aquifer. A salt tolerant wetlands could prove cost prohibitive as well as difficult to guarantee its survival. The subterranean option has the greatest potential for economy. Biological methods are used to neutralize the acidity and reduce the concentration of metals in the impacted waters. The type and design of a biological system depends on the anticipated flow rates, acidity levels, concentrations and types of metals to be removed, and the desired discharge water quality.

Most biological treatment systems rely on the growth of sulfate-reducing naturally occurring bacteria to reduce the acidity of the solution, and precipitate metals from solution as hydroxides or sulfides. Sulfate-reducing bacteria are obligate anaerobic organisms that oxidize low-molecular-weight organic acids and can use sulfate as an electron acceptor. They grow best in the absence of oxygen and under near-neutral pH conditions.

The key concept is to "feed" the naturally occurring bacteria to temporarily increase their population.

The metal contents of water are decreased by oxidation, hydrolysis, and sulfide precipitation reactions. Growth of the sulfate-reducing bacteria may reduce sulfate concentrations and produce hydrogen sulfides that can react with dissolved metals, including arsenic, iron, copper, nickel, lead, and zinc. The metal sulfides accumulate as insoluble precipitates.

5.5 Post-Closure Monitoring and Contingency Plans

The MMD guidelines require monitoring of revegetation during the bonding period to evaluate revegetation success, and NMWQCC Regulation 3107.A.11 requires the development of post-closure monitoring and contingency plans that are consistent with the terms and conditions of the applicable discharge plan. This section summarizes the general approach that will be used to meet these requirements. Section 8 defines intended sampling from a commercial standpoint.

5.5.1 Erosion and Drainage Control Structures

The reclaimed lands, including those in the industrial PMLU areas, will be visually inspected for signs of excessive erosion (i.e., gulying or extensive rilling), and significant erosion features will be mitigated to prevent future degradation of the site. Drainage channels, diversion structures, retention ponds, and auxiliary erosion control features will be inspected in accordance with professionally recognized standards (e.g., Natural Resources Conservation Service and OSE). Post-construction/reclamation inspection schedules will be developed to include provisions for periodic (annual or semiannual) and extreme event monitoring as appropriate for individual facilities.

Monitoring of site water quality will be accomplished through sampling and analysis of potentially impacted water at site locations.

Samples will be collected four times per year (quarterly) at each groundwater monitoring well location (twenty interceptor wells at the tailing and five interceptor wells at the stockpiles). Samples will also be collected four times per year (quarterly) at each surface water collection point (three in-pit sumps and three in-pit seep locations). Sample collection will be done in-house or under contract by an independent environmental engineering firm.

Collected samples will be shipped to an independent analytical laboratory for analysis of constituents of concern. A report will be prepared to document the sampling and analysis for review and recording by site management and review by regulatory authorities.

The water treatment plant will be on a continuous schedule of sampling and recording for operational control. Automatic samplers will be employed to collect composite samples of influent and effluent streams. Each month one composite sample of water treatment plant influent and one composite sample of water treatment plant effluent will be shipped to an independent analytical laboratory for analysis of constituents of concern. A report will be prepared to document the sampling and analysis for review and recording by site management and review by regulatory authorities.

Chino will report evidence of excessive erosion and/or structural failures to the appropriate agencies (MMD, NMED, OSE) in a timely manner. A written report detailing the nature and extent of the problem and a corrective action plan will be developed within 75 days after the problem is identified.

5.5.2 Revegetation Success Monitoring

The reclaimed and surrounding undisturbed areas will be monitored periodically after the final grading and the initial establishment of vegetation on the reclaimed lands. Inspections will be made to determine the initial success of the seeding. Vegetation monitoring will be conducted periodically starting 3 to 4 years after initial establishment of vegetation on the reclaimed lands. Vegetation will be monitored more frequently in the years prior to the bond release determination than in the mid-term period, and the monitoring frequency may be determined by the relative success of the reclamation during the mid-term evaluation, and the reclamation success standards.

5.5.3 Surface Water Quality

Surface water quality will be monitored to determine the effectiveness of the reclamation. Post-closure surface water monitoring locations and schedules will be established in consultation with the NMED. Chino proposes to monitor water quality in Axiflo Lake, Reservoirs 5, 8, 4A, and 17, and on the major streams draining the permit area (i.e., Lampbright Draw and Whitewater and Hanover Creeks). The water samples will be analyzed to determine total suspended sediment and dissolved constituents required to demonstrate compliance with applicable standards. The results of the surface water quality monitoring will be reported to the NMED Surface Water Quality Bureau (SWQB). Should confirmed water quality exceedances or significant degradation of water quality occur, a corrective action plan will be developed and submitted to the SWQB and MMD.

5.5.4 Groundwater Quality

Groundwater quality will be monitored throughout the post-closure period. The intent of the groundwater monitoring is to evaluate the effectiveness of the reclamation and groundwater containment systems and demonstrate compliance with applicable regulations and standards. The monitoring schedule, analytical requirements, location, and construction specifications for the monitor wells will be determined in consultation with the NMED. The analytical results will be reported to the NMED on a semiannual basis.

Contingency plan(s) for post-closure exceedances will be developed on a site-specific basis. In general, the contingency plans for groundwater will

be consistent with the protocols established for NMWQCC Regulation 1203 (notification of discharge). Thus, Chino will verify potential exceedances, report exceedances to NMED within 24 hours of confirmation, prepare a corrective action plan for mitigation within 75 days, and implement the mitigative measures within a reasonable period of time. The corrective action plan will be developed and implemented in collaboration with the NMED.

5.6 Cover Design

5.6.1 Introduction

The cover design proposed for Chino is part of a reclamation plan that includes complementary surface and subsurface water control measures. From a cover design perspective, the Chino facilities are separated into two discrete areas, the North Mine Area and the South Mine Area. The North Mine Area includes the open pit, stockpiles, and surrounding terrain along Whitewater Creek. The South Mine Area encompasses the lands around the tailing ponds. The top surfaces of the stockpiles represent the primary areas where a soil cover can be applied and revegetated in the North Mine Area. The tailing ponds are the primary reclamation units in the South Mine Area. Differences in the type and availability of cover materials differentiate these two areas and dictate the cover design.

5.6.2 South Mine Area

Chemical and physical conditions in the surface layer of the tailing ponds limit their use as primary reclamation substrates. In addition, the tailings are highly susceptible to wind and water erosion and a soil cap is necessary to prevent dispersion of these materials in the environment. Large portions of the inactive tailing ponds have been capped with local soils to reduce dispersion by wind.

Significant volumes of primary (31 million cubic yards (MCY)) and secondary (190 MCY) root zone materials exist within the permit area around the tailing ponds. The primary materials have few or no inherent limitations for supporting native and adapted plant species. The secondary materials can be used in a variety of reclamation applications, including plant growth media, but their use may require special design considerations to overcome the limitations associated primarily with coarse-textures and elevated rock fragment contents. Because the unconsolidated geologic materials around the tailing ponds are thick and the residual materials left after excavation will support vegetation, the soils surrounding the tailing ponds are suitable for the development of borrow areas.

Site-specific soil water studies suggest that the threshold profile available water capacity (PAWC) for the soils in this area is about 2.5 inches. The soil water simulations assumed little or no runoff and no interception of precipitation by vegetation and are considered to be conservative. Field observations of the distribution of mineral precipitates (calcium carbonate) in the soil support the model simulations. The threshold PAWC concept defines the optimum soil thickness needed to meet the normal climatically dictated water requirements of locally adapted upland plants. Thus, for soils with adequate PAWC, vegetation growth will be limited by ambient weather conditions associated with normal periods of drought and not the ability of the soil to supply water. Furthermore, the volume of water that moves through a cover with threshold PAWC is expected to be minor under normal conditions. Significant water movement through the cover is likely to occur in association with unusually wet winters, as opposed to extreme summer events.

Threshold PAWCs can be achieved with 18 to 24 inch thick covers depending on the nature of the soils. From a plant growth and erosion protection perspective, the best available materials in the South Mine Area to meet the threshold PAWC condition in the cover are moderately coarse-to medium-textured soils with low to moderate rock fragment contents (10 to 35 percent). Soils with these characteristics occur extensively around the tailing ponds. Soils included in the sandy texture group (sands and loamy sands) and those containing excessive rock fragments (> 50 % by volume) should be avoided. Soils in the clayey texture groups (sandy clay, silty clay and clay) can be used in cover construction, but should be restricted to the subsurface to avoid excessive erosion and crusting-related germination failures.

5.6.3 North Mine Area

The majority of the waste rock in the North Mine Area possesses some physical and/or chemical limitation with respect to suitability as primary reclamation substrates. Based on site-specific studies the unaltered waste materials have the capacity to support a limited range of plant species, but cover materials with more benign character are needed to facilitate vegetation success and reclamation of the stockpiles.

Conventional topsoil resources are scarce in the North Mine Area. Like most historic hard rock mines, the pre-mining soils were not salvaged and stockpiled for reclamation as mining progressed at Chino. The soils in the vicinity of the North Mine Area are generally of marginal quality, thin, or practically unsalvageable because of topographic limitations. Thus, even if the soils had been salvaged prior to mining it is unlikely that significant high quality resources would be available for reclamation.

A potential borrow area in the northwest corner of the permit area that is estimated to contain about 1.3 MCY of topdressing. Development of this borrow area will result in further disturbance and cultural constraints (Turnerville Cemetery) may restrict the amount of available material. About 1.6 MCY of primary and secondary materials could be salvaged in association with development of the Lampbright area. However, some of these resources may have been used in liner construction in the Lampbright area or are practically unsalvageable. Additionally, it is important to note that soils in the Lampbright area may be salvaged as the area is developed, but because the soils are too shallow the area is not suitable for the development of borrow areas.

The best available topdressing resource in the North Mine Area is overburden composed of Kneeling Nun Rhyolite (KNR) and Sugarlump Tuff. The Sugarlump tuff is generally considered to be volumetrically insignificant and is included with the discussion of the KNR. The KNR is currently being segregated as a reclamation resource on the upper south stockpile and about 50 MCY will be available for closure purposes based on current life-of-mine estimates. The KNR has no apparent chemical limitations for the growth of adapted species, although high rock fragment contents and low available water capacities may limit the use of this material. These limitations are offset by the high value of this material with respect to long-term stability and erosion resistance.

Covers constructed of KNR will provide excellent long-term erosion protection. Once vegetation is established the KNR cover will reduce the amount of water entering the underlying wastes. However, because of the low available water capacity, covers constructed from KNR may require provisions for water control in areas outside of the capture zone of the pit.

**Table 5-1. Summary of Tailing Pond Dimensions in 1998/2006
Footprinted Area**

Chino Facility		Area		
		Top Surface (acres)	Outslopes (acres)	Total (acres)
Lake One	1998/2006	220	0	220
Tailing Pond 1	1998/2006	134	25	159
Tailing Pond 2	1998/2006	120	30	150
Axiflo Lake	1998/2006	88	3	91
Tailing Pond B	1998/2006	178	60	238
Tailing Pond C	1998/2006	98	60	158
Tailing Pond 4	1998/2006	318	44	362
Tailing Pond 6 West	1998/2006	339	86	425
Tailing Pond 6 East	1998/2006	356	72	428
Tailing Pond 7	1998	1,345	218	1,563
Tailing Pond 7	2006	1,198	365	1,563
2006 Total		3,049	745	3,794

**Table 5-2. Summary of Stockpile Dimensions in 1998
Footprinted Areas**

Facility	Area		
	Top Surface (acres)	Outslopes (acres)	Total (acres)
West Stockpile	293	251	544
South Stockpile	230	353	583
Upper South Stockpile	65	39	104
East Pit Perimeter Access	5	34	39
Northeast Stockpile	30	48	78
Main Lampbright Stockpile	264	226	490
South Lampbright Stockpile	92	37	129
Southwest Lampbright Stockpile	52	28	80
North Stockpile	5	13	18
Northwest Stockpile	7	13	20
Groundhog No. 5 Stockpile	1	1	2
Total	1,044	1,043	2,087

**Table 5-3. Summary of Projected Stockpile Dimensions in 2006
Footprinted Areas**

Facility	Proposed Plan Area			Comparison Case Area		
	Top Surface (acres)	Outslopes (acres)	Total (acres)	Top Surface (acres)	Outslopes (acres)	Total (acres)
West Stockpile	141	390	531	85	536	621
South Stockpile	204	431	635	86	562	648
Upper South Stockpile (Borrow)	9	143	152	9	143	152
East Pit Access	5	40	45	5	40	45
Northeast Stockpile	5	72	77	7	104	111
North Lampbright Stockpile	150	22	172	158	81	239
Main Lampbright Stockpile	171	181	352	85	367	452
South Lampbright Stockpile	92	110	202	19	110	219
Southwest Lampbright Stockpile	33	66	99	19	93	112
North Stockpile	13	7	20	7	20	27
Northwest Stockpile (Borrow)	7	13	20	7	13	20
Groundhog No. 5 Stockpile	1	1	2	1	1	2
Total	831	1,476	2,307	488	2,070	2,558

**Table 5-4. Summary of Santa Rita Open Pit Dimensions in 1998
Footprinted Areas**

Pit Area	Area		
	Bottom (acres)	Sideslopes (acres)	Total (acres)
East pit area	3.2	705	708.2
Estrella pit area	2.6	546	548.6
Lee Hill pit area	0.5	504	504.5
Total	6.3	1,755	1,761.3

**Table 5-5. Summary of Projected Santa Rita Open Pit Dimensions in 2006
Footprinted Areas**

Pit Area	Area		
	Bottom (acres)	Sideslopes (acres)	Total (acres)
East pit area	3	745	748
Estrella pit area	3	638	641
Lee Hill pit area	0.5	504	505
Total	7	1,887	1,894

Table 5-6. Summary of Reservoir Function and 1998 Dimensions

Reservoir/ Dam	Disturbed Area (acres)	General Location	Subgroup	Closure/Closeout Function
2	0.4	South of Ivanhoe Concentrator	Retention	Reclaimed
3A	50	South of Upper South Stockpile	Retention	Reclaimed, stormwater collection
4A	1.25	Southeast of Ivanhoe Concentrator	Retention	Post-closure water management
5	11	North of Northeast Stockpile	Retention	Upgradient runoff control
6	10.5	Northwest of SX/EW Plant	Retention	Reclaimed
7	29.5	Southwest of SX/EW Plant	Retention	Reclaimed, stormwater collection
8	1.5	Southeast of South Lampbright Stockpile	Retention	Post-closure water management
9	11	East of Reservoir 3A	Retention	Reclaimed
10	<0.1	Western side of West Stockpile	Detention	Post-closure water management
11	<0.1	Western side of West Stockpile	Detention	Post-closure water management
12	<0.1	Western side of West Stockpile	Detention	Post-closure water management
13	<0.1	Western side of West Stockpile	Detention	Post-closure water management
14	<0.1	Western side of West Stockpile	Detention	Post-closure water management
14-1	<<0.1	Western side of West Stockpile	Detention	Post-closure water management
14-2	<<0.1	Western side of West Stockpile	Detention	Post-closure water management
15	1	South of mine entrance road, 500 feet west of lay down yard by concentrator	Detention	Post-closure water management
16	3	2,200 feet down Whitewater Creek from Last Chance Reservoir	Detention	Intercepts infiltrated alluvial flow from Whitewater Creek
17	M0.1	Directly downgradient of Last Chance Reservoir	Retention	Emergency runoff
18	<0.1	300 feet west of Dam 11	Detention	Seepage from Reservoir 11
19	<0.1	200 feet west of Dam 13	Detention	Seepage from Reservoir 13
20	<0.1	Adjacent to North side of mine entrance road by abandoned guard shack near concentrator	Detention	Post-closure water management
PLS Pond	<0.1	Adjacent to South Stockpile and upgradient of Reservoir 4A	Retention	Post-closure water management
SS Booster	<0.1	Southwest end of South Stockpile	Retention	Reclaimed
Axiflo Lake	88	North of Tailing Pond 4	Retention	Post-closure water management

**Table 5-7. Summary of Disturbed Area Dimensions in 2001/2006
Footprinted Areas**

Disturbed Area	Area (acres)
Misc. Roads	50
Reservoirs	320
Facility Demolition	170
Pipeline Corridor	40
Total	580

Table 5-8. Tailing Pond Long-Term Slope Stability: Factor Of Safety

Closure Areas	Closure Items	Min. Static FOS	Min. Pseudo Static FOS
Tailing Ponds (South Mine Area)	Older Tailing Ponds:	1.60	1.22
	Tailing Pond 1	1.60	1.22
	Tailing Pond 2	1.60	1.22
	Tailing Pond 4	1.60	1.22
	Tailing Pond B	1.60	1.22
	Tailing Pond C	1.60	1.22
	Tailing Pond 6E	1.60	1.22
	Tailing Pond 6W	1.60	1.22
	Tailing Pond 7	3.06	2.00

Table 5-9. Stockpile Long-Term Slope Stability: Factor Of Safety

Closure Areas	Closure Items	Min. Static FOS	Min. Pseudo Static FOS
Stockpiles (North Mine Area)	West Stockpile	1.42	1.14
	South Stockpile	1.52	1.22
	Upper South Stockpile	4.09	3.21
	Main Lampbright Stockpile	1.93	1.56
	South Lampbright Stockpile	1.93	1.56
	Southwest Lampbright Stockpile	1.93	1.56
	Northeast Waste Rock Stockpile	2.80	2.20
	North Pit Leach Stockpile	2.29	2.07

Table 5-10. Borrow Areas

Borrow Area	Where to be Used	Available Cubic Yards
Northeast Stockpile Rhyolite	Tailing Ponds & Misc. Disturbed Areas (South Mine Area)	2,000,000
Upper South Stockpile Predominantly Kneeling Nun Rhyolite, Trace Amounts Sugarlump Tuff	Tailing Ponds & Misc. Disturbed Areas (South Mine Area)	50,000,000
Gila Conglomerate Adjacent to Ponds C, 6 & 7 Primary Root Material	Stockpiles & Misc. Disturbed Areas (North Mine Area)	31,000,000
Gila Conglomerate Adjacent to Ponds C, 6 & 7 Secondary Root Materials	Stockpiles & Misc. Disturbed Areas (North Mine Area)	190,000,000

Table 5-11. Chino Mines Company - CCP Water Balance Methodology

Post-mining leaching period	10	years
Base leaching flowrate	20,000	gallons/minute
Circulation loss factor	10%	percent
Active stockpile toe flow	200	gallons/minute
Inactive stockpile toe flow	-	gallons/minute
Active stockpile GW seepage	200	gallons/minute
Inactive stockpile GW seepage	100	gallons/minute
Time to reach GW seepage steady state	20	years
Base tailing interceptor flow	2,820	gallons/minute
Minimum tailing interceptor flow	500	gallons/minute
Time to reach tailing steady state	50	years
Maximum pit inflow	500	gallons/minute
Steady-state pit inflow	400	gallons/minute
Time to reach pit inflow steady state	20	years
Initial water in storage	750,000,000	gallons
Evaporation rate	70	inches/year
Maximum Cobre contribution	200	gallons/minute
Time for Cobre to reach zero contribution	30	years

Year	Leaching flowrate (gpm)	Circulating Inventory (gallons)	Circulation Loss (gpy)	Leaching makeup water requirements (gpm)			Flows to water treatment plant (gpm)			% active operation	Seepage collection volumes (gpm)					Tailing interceptor volumes (gpm)			Evaporative area required (acres)
				Total needed	Available from seeps and pit inflows	Required from pits and reservoirs	Total	Active flows	Stored water/ excess cap.		Stockpile Toes	Stockpile Interceptor	Pit Inflow	Cobre	Outslope Stormwater	Total	To evaporation	To dilution	
1	20,000	1,296,000,000	1,051,200,000	1,753.42	1,200.00	553.42	-	-	-	100%	200.00	200	500	200	100	2,820	2,820	-	780
2	18,000	1,166,400,000	946,080,000	1,553.42	1,156.67	396.76	-	-	-	90%	180.00	195	495	187	100	2,774	2,774	-	754
3	16,000	1,036,800,000	840,960,000	1,353.42	1,120.00	233.42	-	-	-	80%	160.00	190	490	180	100	2,727	2,727	-	767
4	14,000	907,200,000	735,840,000	1,153.42	1,083.33	70.09	-	-	-	70%	140.00	185	485	173	100	2,681	2,681	-	741
5	12,000	777,600,000	630,720,000	953.42	1,046.67	-	-	-	-	60%	120.00	180	480	167	100	2,634	2,634	-	728
6	10,000	648,000,000	525,600,000	753.42	1,010.00	-	-	-	-	50%	100.00	175	475	160	100	2,588	2,588	-	716
7	8,000	518,400,000	420,480,000	553.42	973.33	-	-	-	-	40%	80.00	170	470	153	100	2,542	2,542	-	703
8	6,000	388,800,000	315,360,000	353.42	936.67	-	-	-	-	30%	60.00	165	465	147	100	2,495	2,495	-	690
9	4,000	259,200,000	210,240,000	153.42	-	153.42	1,000	900	100	20%	40.00	160	460	140	100	2,449	-	2,449	-
10	2,000	129,600,000	105,120,000	-	-	-	1,000	863	137	10%	20.00	155	455	133	100	2,402	-	2,402	-
11	-	-	-	-	-	-	1,000	827	173	0%	-	150	450	127	100	2,356	-	2,356	-
12	-	-	-	-	-	-	1,000	810	190	0%	-	145	445	120	100	2,310	-	2,310	-
13	-	-	-	-	-	-	1,000	793	207	0%	-	140	440	113	100	2,263	-	2,263	-
14	-	-	-	-	-	-	1,000	777	223	0%	-	135	435	107	100	2,217	-	2,217	-
15	-	-	-	-	-	-	1,000	760	240	0%	-	130	430	100	100	2,170	-	2,170	-
16	-	-	-	-	-	-	1,000	743	257	0%	-	125	425	93	100	2,124	-	2,124	-
17	-	-	-	-	-	-	1,000	727	273	0%	-	120	420	87	100	2,078	-	2,078	-
18	-	-	-	-	-	-	1,000	710	290	0%	-	115	415	80	100	2,031	-	2,031	-
19	-	-	-	-	-	-	1,000	693	307	0%	-	110	410	73	100	1,985	-	1,985	-
20	-	-	-	-	-	-	1,000	677	323	0%	-	105	405	67	100	1,938	-	1,938	-
21	-	-	-	-	-	-	1,000	660	340	0%	-	100	400	60	100	1,892	-	1,892	-
22	-	-	-	-	-	-	1,000	653	347	0%	-	100	400	53	100	1,846	-	1,846	-
23	-	-	-	-	-	-	1,000	647	353	0%	-	100	400	47	100	1,799	-	1,799	-
24	-	-	-	-	-	-	1,000	640	360	0%	-	100	400	40	100	1,753	-	1,753	-
25	-	-	-	-	-	-	1,000	633	367	0%	-	100	400	33	100	1,706	-	1,706	-
26	-	-	-	-	-	-	1,000	627	373	0%	-	100	400	27	100	1,660	-	1,660	-
27	-	-	-	-	-	-	1,000	620	380	0%	-	100	400	20	100	1,614	-	1,614	-
28	-	-	-	-	-	-	1,000	613	387	0%	-	100	400	13	100	1,567	-	1,567	-
29	-	-	-	-	-	-	1,000	607	393	0%	-	100	400	7	100	1,521	-	1,521	-
30	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,474	-	1,474	-
31	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,428	-	1,428	-
32	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,382	-	1,382	-
33	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,335	-	1,335	-
34	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,289	-	1,289	-
35	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,242	-	1,242	-
36	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,196	-	1,196	-
37	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,150	-	1,150	-
38	-	-	-	-	-	-	1,000	600	400	0%	-	100	400	-	100	1,103	-	1,103	-

**Table 5-12. Lime Treatment Influent Water Quality
And Effluent Requirements**

Parameter	Influent Quality	Effluent Requirements	Units
8270 SVOC	<0		ppb
Alkalinity (bicarbonate)	<1		mg/L
Alkalinity (carbonate)	<1		mg/L
Aluminum	2,000	5.0	mg/L
Arsenic	--	0.1	mg/L
Boron	--	0.75	mg/L
Cadmium	0.14	0.01	mg/L
Calcium	473		mg/L
Chloride	36.8	250.0	mg/L
Chromium	<0.06	0.05	mg/L
Cobalt	6.89	0.05	mg/L
Conductivity	5,930		µmhos/cm
Copper	167	1.0	mg/L
Ethylbenzene	<1		ppb
Fluoride	21	1.6	mg/L
Iron	487	1.0	mg/L
Lead	4.94	0.05	mg/L
Magnesium	872		mg/L
Manganese	168	0.2	mg/L
Molybdenum	--	1.0	mg/L
Napthalene	<1		ppb
Nickel	1.95	0.2	mg/L
PH	2.6	6-9	s.u.
Potassium	<10		mg/L
Selenium	--	0.05	mg/L
Sodium	45		mg/L
Sulfate	8,030	600.0	mg/L
Toluene	<1		ppb
Total Dissolved Solids	13,300	1000.0	mg/L
TPH	<1		mg/L
TPH-Kerosene	<0.2		ppb
Vanadium	--	0.1	mg/L
Zinc	48.9	10.0	mg/L

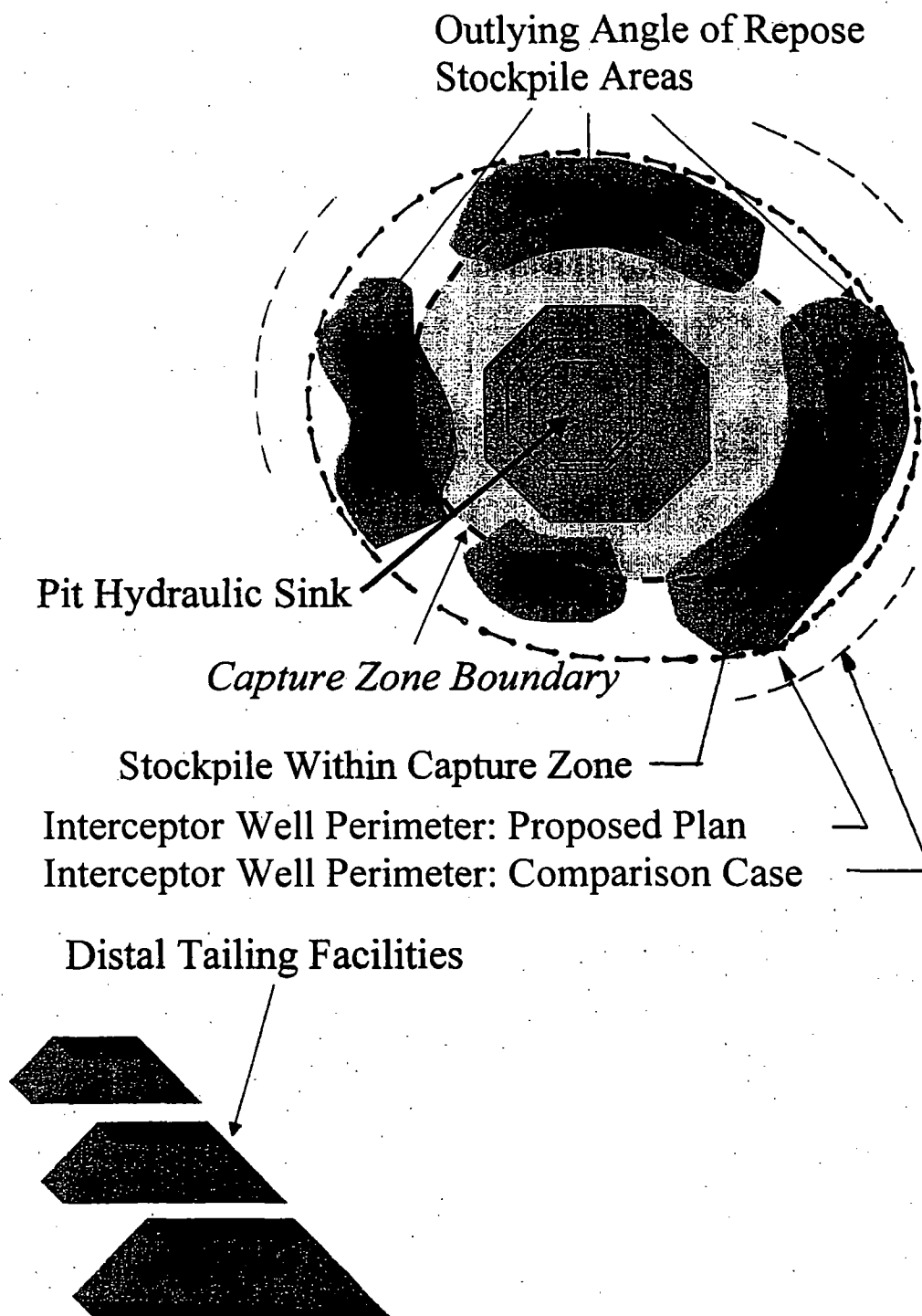


Figure 5-1. Conceptual Mine System Divisions

6. Summary of Closure/Closeout Activities

This section summarizes the existing and planned closure/closeout activities for the Chino Mine, the general approach and rationale for which was described in Section 5. A description of the existing mine facilities to be closed is provided in Section 2. Section 3 discusses existing site conditions and existing facilities located within each DP area as well as site-specific information on hydrologic conditions, known and potential impacts to the environment, and the engineering controls currently in operation. Details on those facilities not located within a DP area (the mine maintenance facilities area and the Groundhog Mine) are provided in Section 2. The proposed South Mine Area topdressing borrow pit is also located outside of current DP area boundaries.

6.1 Discharge Plan Areas

The general conceptual design approaches, their limits, and the rationale for closure/closeout of the facility groups identified in Section 5.1 are discussed in Section 5.2. This section describes specific details regarding the individual facilities to be closed within each of the DP areas (Sections 6.1.1 through 6.1.8). Mining facilities that are not located within the DP areas are discussed in Section 6.2.

6.1.1 Lampbright Stockpiles and Reservoir 8, DP-376 Area

The DP-376 area is discussed in detail in Section 3.2.1. Figure 6-1 shows the mining facilities within the DP-376 area, while Figure 6-2 provides information on the characteristics of the mining components in that area as of November 1998.

6.1.1.1 Mining Facilities To Be Closed

Mining facilities to be closed in the DP-376 area include:

- The Lampbright stockpiles and the associated disturbed area
- Selected seepage/runoff collection sumps and impoundments along the north side of the Main Lampbright stockpile
- Miscellaneous pipelines for raffinate, PLS, and groundwater, except those that may be used in a post-closure water management system

The combined Lampbright leach stockpile has a footprint of about 699 acres. The Main Lampbright stockpile has 226 acres covered by sideslopes and 264 acres of top surface area. The South Lampbright stockpile has 37 acres covered by sideslopes and 92 acres of top surface area. The Southwest Lampbright

waste rock stockpile has a footprint of 80 acres, with 28 acres covered by sideslopes and 52 acres of top surface area. Reservoir 8 covers 1.5 acres and will be an integral part of the post-closure sediment and surface water management system. The few auxiliary structures in the DP-376 area will be removed and salvaged upon closure.

6.1.1.2 Existing Closure Components

Closure activities and related engineering controls implemented to date in the DP-376 area include:

- Construction and maintenance of stockpile top surface perimeter berms
- Installation, operation, and maintenance of existing toe control systems, including the process water interceptor system along the north and east sides of the Main Lampbright stockpile and the groundwater extraction system along the Nancy Fault
- Diversion of excess surface water runoff from undisturbed terrain north of the Main Lampbright stockpile along the North Diversion Channel into Tributary 2
- Diversion of stormwater runoff south of the Lampbright stockpiles into a number of impoundments in Tributary 1 to reduce peak flows into Reservoir 8

These existing controls are discussed in Section 3.2.1 and shown on Figure 6-2.

6.1.1.3 Planned Closure/Closeout Activities

The closure/closeout activities planned for the DP-376 area consist of:

- Remove remaining debris and solid waste and dispose of it in an approved manner.
- Flush the raffinate and PLS pipelines with water to remove residual solutions.
- Grade the stockpile top surfaces as necessary to support placement of the cover and provide appropriate drainage.

- Cover the top surfaces (including the haul roads, unused pipelines, and berms) with nominally 24 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Construct spillways and down chutes as necessary to direct excess water off the covered top surfaces.
- Construct runoff controls on the west side of the Southwest Lampbright stockpile and the disturbed area associated with the Lampbright stockpile.
- For the comparison case, push stockpile outslopes down to an average slope of 4(H):1(V).
- For the comparison case, cover stockpile outslopes with 36 inches of top dressing.
- Provide drainage systems to control erosion of the stockpile outslopes and maximize the segregation of non-impacted and potentially impacted runoff.
- Provide additional channels, sumps, wells, pumps, and pipelines to direct impacted water to a site-wide water treatment facility. Channels to have energy dissipaters as required.
- Provide facilities to discharge non-impacted stockpile runoff.
- Grade the disturbed area associated with the stockpiles to provide positive drainage.
- For the proposed plan, cover disturbances with 18 inches of topdressing. For the comparison case, provide 36 inches of topdressing.
- Revegetate covered and disturbed areas with grasses, shrubs, and forbs.
- For the comparison case, provide replacement toe drains, sumps and interception and monitoring wells as required.

6.1.2 SX/EW and Reservoirs 6 and 7, DP-591 Area

The DP-591 area is discussed in detail in Section 3.2.2. Figure 6-1 shows the mining facilities within the DP-591 area, while Figure 6-2 provides information on the characteristics of the mining components in that area as of November 1998.

6.1.2.1 Mining Facilities To Be Closed

The SX/EW plant and its associated facilities will be maintained for use as one of the industrial PMLU areas. Existing pipelines, tanks, ponds, and other facilities will be left in place and maintained by Chino. Reservoir 7 is expected to serve as a stormwater pond. Therefore, the main facility to be closed in the DP-591 area is Reservoir 6.

The SX/EW plant area covers about 60 acres. Reservoir 6 covers 10.5 acres, and Reservoir 7 covers 29.5 acres.

6.1.2.2 Existing Closure Components

Closure activities and related engineering controls implemented to date in the DP-591 area include:

- Installation and operation of an interceptor well system
- Installation and maintenance of stormwater management controls, including the North Diversion Channel and the raffinate overflow pond
- The use of lined impoundments for process water storage and Reservoir 7 for stormwater management

A number of these controls are discussed in Section 3.2.2 and shown on Figure 6-2.

6.1.2.3 Planned Closure/Closeout Activities

Planned site-specific closure/closeout activities for the DP-591 area consist of:

- Drain and grade Reservoir 6 to provide positive drainage.
- Cover with 18 inches of topdressing in the proposed plan and 36 inches in the comparison case.

- Revegetate covered and disturbed areas with grasses, shrubs, and forbs.
- Drain Reservoir 7, remove and dispose of (e.g., to a permitted leach facility) impacted sediments, cover the pond with nominally 12 inches of topdressing and use it as a sediment/stormwater control feature for the industrial PMLU area.
- In the immediate SX/EW plant area:
 - Flush the PLS, raffinate, and other pipelines with water to remove accumulated sediment.
 - Remove all debris and visually affected soil at or near the surface.
 - Dispose of debris or affected soil in an approved manner.
 - Collect confirmation samples from areas where soils were removed.
 - Cover unpaved areas with nominally 18 inches of topdressing in the proposed plan and 36 inches in the comparison case.
 - Revegetate with grasses, forbs, and shrubs.

6.1.3 North Pit Stockpiles, Reservoir 5, and Santa Rita Pit, DP-459 Area

The DP-459 area is discussed in detail in Section 3.2.3. Figure 6-3 shows the mining facilities within the DP-459 area, while Figure 6-4 provides information on the characteristics of the mining components in that area as of November 1998.

6.1.3.1 Mining Facilities To Be Closed

Mining facilities to be closed at the DP-459 area include:

- The North Stockpile and associated disturbed areas
- The Santa Rita pit

- Miscellaneous pipelines for raffinate, PLS, and stormwater/groundwater, except those that may be used in the post-closure water management system

The North Pit Leach (in-pit) stockpile has a footprint of 53 acres, with 6.4 acres covered by sideslopes and 47 acres of top surface area. The Northwest waste rock (cover) stockpile has a footprint of 20 acres, with 13 acres covered by sideslopes and 7 acres of top surface area. The North waste rock stockpile has a footprint of 18 acres, with 13 acres covered by sideslopes and 5 acres of top surface area. The Northeast waste rock stockpile has a footprint of 67 acres, with 48 acres covered by sideslopes and 30 acres of top surface area. The Santa Rita pit is about 1,760 acres in area and presently consists of three pit areas with incipient pit lakes: the Lee Hill, Estrella, and East Pit areas. The few auxiliary structures in the DP-459 area will be removed and salvaged upon closure.

6.1.3.2 Existing Closure Components

Closure activities and related engineering controls implemented to date at the DP-459 area include:

- Construction and maintenance of stockpile top surface perimeter berms
- Installation, operation, and maintenance of existing toe control systems for the stockpiles, including the process water collection system along the south side of the North Leach portion of the North Stockpile and the pit dewatering system
- Diversions of surface water runoff in upper Santa Rita Creek from Reservoir 5 (which covers 11 acres) into the North Diversion Channel

A number of these existing controls are discussed in Section 3.2.3 and shown on Figure 6-4.

6.1.3.3 Planned Closure/Closeout Activities

The closure/closeout activities planned for the DP-459 area consist of the following:

For the Stockpiles:

- Remove remaining debris or solid waste and dispose of it in an approved manner.
- Flush the raffinate and PLS pipelines with water to remove residual solutions.
- Grade the stockpile top surfaces as necessary to support placement of the cover and provide appropriate drainage.
- For the comparison case, push stockpile outslopes down to an average slope of 4(H):1(V).
- For the comparison case, cover stockpile outslopes with 36 inches of topdressing.
- Cover the top surfaces, (including the haul roads, unused pipelines, and berms) with 24 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Construct spillways and down chutes as necessary to direct excess water off the covered top surfaces.
- Construct runon controls on the west side of the Southwest and Main Lampbright stockpiles, and on the north side of the North Lampbright stockpile.
- Provide drainage systems to control erosion of the stockpile outslopes and maximize the segregation of non-impacted and potentially impacted stockpile runoff.
- Revegetate covered and disturbed areas with grasses, shrubs, and forbs.
- Provide additional channels, sumps, wells, pumps, and pipelines to direct impacted water to a site-wide water treatment facility.
- Provide facilities to discharge non-impacted stockpile runoff.

- For the Northwest Stockpile which will be consumed for use as a topdressing material, grade to provide appropriate drainage, rip surfaces and revegetate.
- Grade and cover disturbed areas associated with the stockpile with 18 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- For the comparison case, provide replacement toe drains, sumps, interceptor and monitoring wells as required.

For the Santa Rita Pit:

- Construct a berm and security fence around the pit crest perimeter to control runoff and access.
- Provide and/or maintain sumps, pumps, and pipelines on the pit floor to capture and transfer impacted water to the site-wide water treatment facility.
- Provide groundwater interceptor wells.

For miscellaneous pipelines not incorporated in the post-closure water management system:

- Flush the raffinate and PLS pipelines with water.
- Salvage or bury pipelines with 18 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Revegetate covered areas.

6.1.4 Reservoir 3A, DP-493 Area

The DP-493 area is discussed in detail in Section 3.2.4. Figure 6-5 shows the mining facilities within the DP-493 area while Figure 6-6 provides information on the characteristics of the mining components in that area as of November 1998.

6.1.4.1 Mining Facilities To Be Closed

Mining facilities to be closed at the DP-493 area include miscellaneous pipelines for raffinate, except those that may be used in the post-closure water management system or for stormwater control. Reservoir 3A, which covers 50 acres, will be used for stormwater collection as part of the post-closure surface water control system.

6.1.4.2 Existing Closure Components

Engineering controls implemented to date in the DP-493 area that may have a post-closure purpose include periodic pumping of well 3A-5 to remove impacted groundwater. This control measure is discussed in Section 3.2.4.

6.1.4.3 Planned Closure/Closeout Activities

The closure/closeout activities planned for the DP-493 area consist of:

- Flush the pipelines with water to remove residual solutions.
- Salvage or bury redundant pipelines with 18 inches of cover in the proposed plan and 36 inches of cover in the comparison case.
- Pump the remaining water in Reservoir 3A to an appropriate discharge point or allow the water to evaporate. Remove and dispose of (e.g., to a permitted leach facility) impacted sediments, and cover the reservoir area and associated disturbed areas with 12 inches of topdressing.
- Revegetate disturbed and covered areas with grasses, shrubs, and forbs.
- Use the reservoir for stormwater control during the post mining period.

6.1.5 Whitewater Stockpiles and Facilities, DP-526 Area

The DP-526 area is discussed in detail in Section 3.2.5. Figures 6-5 and 6-7 show the mining facilities within the DP-526 area, while Figures 6-6 and 6-8 provide information on the characteristics of the mining components in that area as of November 1998.

6.1.5.1 Mining Facilities To Be Closed

Mining facilities to be closed at the DP-526 area include:

- The West and South stockpiles and associated disturbed areas
- Reservoir 2 and associated disturbed areas
- Miscellaneous pipelines for raffinate, PLS, and stormwater, except those that may be used in the post-closure water management system

The West stockpile has a footprint of 544 acres, with 251 acres covered by sideslopes and 293 acres of top surface area. The South stockpile has a footprint of 583 acres, with 353 acres covered by sideslopes and 230 acres of top surface area. The Upper South stockpile has a footprint of 206 acres, with 39 acres covered by sideslopes and 65 acres of top surface area. Reservoir 2 covers 0.4 acre.

Reservoirs 4A and 17 and the impoundments, catchment structures, and for the proposed plan sumps at the toes of the West and South stockpiles will be maintained as part of the post-closure water management system. For the comparison case, these toe sumps will be buried by outslope pushdown.

6.1.5.2 Existing Closure Components

Closure activities and related engineering controls implemented to date in the DP-526 area include:

- Construction and maintenance of stockpile top surface perimeter berms
- Installation, operation, and maintenance of existing toe control systems, including the sediment, stormwater, seepage, and groundwater interceptor systems along the west side of the West stockpile and the South stockpile PLS collection system and sand traps
- Diversion of stormwater runoff into Reservoir 4A
- Water management (Reservoir 17) and alluvial groundwater interceptor systems (Dam 16) along upper Whitewater Creek

A number of these existing controls are discussed in Section 3.2.5 and shown on Figures 6-6 and 6-8.

6.1.5.3 Planned Closure/Closeout Activities

The closure/closeout activities planned for all the West and South stockpiles except the Upper South stockpile consist of:

- Remove remaining debris and solid waste and dispose of it in an approved manner.
- Flush the raffinate and PLS pipelines with water to remove residual solutions.
- Grade the stockpile top surfaces as necessary to support placement of the cover and provide appropriate drainage.
- Cover the top surfaces (including the haul roads, unused pipelines, and berms) with nominally 24 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- For the comparison case, push stockpile outslopes down to an average slope of 4(H):1(V).
- For the comparison case, cover stockpile outslopes with 36 inches of top dressing.
- Construct spillways and down chutes as necessary to direct excess water off the covered top surfaces.
- Construct runoff controls on the west side of the Southwest and Main Lampbright stockpiles, and on the north side of the North Lampbright stockpile.
- Provide drainage systems to control erosion of the stockpile outslopes and maximize the segregation of non-impacted and potentially impacted runoff.
- Revegetate covered and disturbed areas with grasses, shrubs, and forbs.
- Provide additional channels, sumps, wells, pumps, and pipelines to direct impacted water to a site-wide water treatment facility.

- Provide facilities to discharge non-impacted stockpile runoff.
- Grade and cover the disturbed area associated with the stockpiles with 18 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- For the comparison case, provide replacement toe drains, sumps and interception and monitoring wells as required.
- For the Upper South Stockpile which will be partly consumed for use as topdressing material, grade to 4(H):1(V) during material removal, rip surfaces and revegetate.

For Reservoir 2 and associated disturbed areas:

- Drain and grade Reservoir 2 to provide positive drainage.
- Cover with 18 inches of topdressing in the proposed plan and 36 inches in the comparison case.
- Revegetate covered and disturbed areas with grasses, shrubs, and forbs.

Reservoir 4A will be used for stormwater and sediment control and storage of solutions collected from the Whitewater stockpile toe control and groundwater interceptor systems.

Reservoir 17 will be maintained for emergency stormwater control.

6.1.6 Ivanhoe Concentrator and Tailing Pipelines, DP--213 Area

The DP-213 area is discussed in detail in Section 3.2.6. Figures 6-5, 6-7, and 6-9 show the mining facilities within the DP-213 area, while Figures 6-6, 6-8 and 6-10 provide information on the characteristics of the mining components in that area as of November 1998.

6.1.6.1 Mining Facilities To Be Closed

Mining facilities to be closed in the DP-213 area include the tailing and concentrate pipelines. The Ivanhoe Concentrator and its associated facilities, which cover about 110 acres, will be maintained for use as an industrial PMLU area. Chino has committed to maintaining the concentrator and its associated

ancillary facilities until a lessee is under contract. Some process water pipelines will be maintained as part of the post-closure water management system.

6.1.6.2 Existing Closure Components

Closure activities and related engineering controls implemented to date at the DP-213 area include stormwater management activities at the Ivanhoe Concentrator area and tailing pipeline spill management systems. These closure activities and controls are discussed in Section 3.2.6.

6.1.6.3 Planned Closure/Closeout Activities

The planned site-specific closure/closeout activities for the DP-213 area consist of:

- Flush the tailing and concentrate pipelines with water to remove accumulated sediment. Pipelines will then be salvaged or buried.
- Maintain culverts and cover over the pipeline corridor to provide positive drainage. In the proposed plan, 18 inches of cover will be provided. In the comparison case the cover thickness will be 36 inches.
- Remove all debris and visually affected soil at or near the surface from the concentrator area.
- Dispose of debris and affected soil in an approved manner.
- Collect confirmation samples from areas where soils were removed.
- Cover unpaved areas with nominally 18 inches of cover in the proposed plan and 36 inches in the comparison case.
- Revegetate covered areas with grasses, forbs, and shrubs.

The site-wide water treatment facility will be located in the DP-213 area adjacent to the Ivanhoe Concentrator. Pipelines transporting impacted water will originate in most of the North Mine Area DP areas. Use of existing sumps, pumps, and pipelines will be maximized. Water treatment plant effluent together with pit groundwater interceptor well water will be transported to the South Mine Area where it will be commingled

with water from existing tailing interceptor water wells and water make-up wells.

Facilities to be installed include:

- A degritting basin
- A water treatment plant feed reservoir
- A chemical precipitation water treatment plant
- A sludge pond for water treatment solid effluent
- Commingling reservoir or tanks, existing reservoirs may be used

6.1.7 Lower Whitewater Creek and Older Tailing Ponds, DP-214 Area

The DP-214 area is discussed in detail in Section 3.2.7. Figures 6-9, 6-11 and 6-13 show the mining facilities within the DP-214 area, while Figures 6-10, 6-12, and 6-14 provide information on the characteristics of the mining components in that area as of November 1998.

6.1.7.1 Mining Facilities To Be Closed

Mining facilities to be closed at the DP-214 area include:

- Lake One
- The older tailing ponds 1, 2, B, C, 4, 6E/6W
- The Tailing Pond 1 landfarm

Lake One covers 220 acres. The six older tailing ponds cover approximately 2,011 acres including outslopes.

6.1.7.2. Existing Closure Components

Closure activities and related engineering controls implemented to date at the DP-214 area include:

- Installation of the smelter area stormwater control system
- Implementation of a dust cover capping program for the older tailing ponds

- Construction of the lower Whitewater Creek diversion in 1998

These existing controls are discussed in Section 3.2.7 and shown on Figures 6-12 and 6-14.

6.1.7.3 Planned Closure/Closeout Activities

Planned closure/closeout activities for the older tailing pond area consist of:

- Construct the upper Whitewater Creek diversion.
- Remove remaining debris and solid waste and dispose of it in an approved manner (e.g., atop a tailing pond).
- Flush the various pipelines that do not have a post-closure purpose with water to remove accumulated sediment.
- Grade the tailing surfaces as necessary to support placement of the cover and provide appropriate drainage. Smooth outslopes to remove erosion channels.
- Cover the tailing pond outslopes, including the slurry pipelines, with 24 inches of topdressing in the proposed plan on 36 inches of topdressing in the comparison case.
- Construct spillways and down chutes as necessary to direct excess water off of the tailing pond surfaces.
- Apply angular rock and construct vee ditches on the tailing pond outslopes to reduce erosion and control runoff.
- Cover the disturbed area associated with the tailing ponds with 18 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Revegetate the covered areas with native grasses, shrubs, and forbs.
- Install groundwater interceptor wells.

Planned closure/closeout activities for Lake One, which has filled with sediment and tailing, are similar to the activities proposed for tailing dams.

Axiflo Lake will be retained for water management activities. As part of closure, the lake will be drained as much as is feasible, and 12 inches of soil or topdressing will be placed to limit exposure of tailing in the shoreline area.

Closure of the landfarm at Tailing Pond 1 will be accomplished in accordance with the landfarm closure plan provided in Appendix H. In summary, this plan includes:

- Remove all treated soil from the landfarm.
- Dispose of gravel and crushed fines on top of the liner in the manner specified for petroleum contaminated soils.
- Treat remaining water or remove it from the site.
- Dispose of the liner in accordance with proper solid waste/hazardous waste disposal regulations.
- Clean up soil contamination outside of the lined area, if present, in an appropriate manner.
- The closed landfarm site will be incorporated into the overall Tailing Pond 1 closure design

6.1.8 Tailing Pond 7, DP-484 Area

The DP-484 area is discussed in detail in Section 3.2.8. Figure 6-13 shows the mining facilities within the DP-484 area, while Figure 6-14 provides information on the characteristics of the mining components in that area as of November 1998.

6.1.8.1 Mining Facilities To Be Closed

Mining facilities to be closed at the DP-484 area include:

- Tailing Pond 7
- The tailing termination tower
- Miscellaneous pipelines for tailing slurry and groundwater
- Auxiliary structures and equipment (buildings and crane-mounted cyclones)

Tailing Pond 7 has a footprint of 1,560 acres with 218 acres covered by sideslopes and 1,345 acres of top surface area. The auxiliary structures in the DP-484 area will be removed and salvaged upon closure.

6.1.8.2 Existing Closure Components

Closure activities and related engineering controls implemented to date at the DP-484 area include:

- Installation and operation of the Tailing Pond 7 interceptor well system.
- Installation and operation of the Tailing Pond 7 seepage collection sump.
- Installation of the 1988 Whitewater Creek diversion.
- Implementation of a dust cover capping program for the Tailing Pond 7 outslopes.

These existing controls are discussed in Section 3.2.8 and shown on Figure 6-14.

6.1.8.3 Planned Closure/Closeout Activities

Planned closure/closeout activities for the Tailing Pond 7 consist of:

- Remove remaining debris and solid waste and dispose of it in an approved manner (e.g., atop a tailing pond).
- Flush the various pipelines that do not have a post-closure purpose with water to remove accumulated sediment.
- Grade the tailing surfaces as necessary to support placement of the cover and provide appropriate drainage. Smooth outslopes to remove erosion channels.
- Cover the tailing pond top surfaces with 18 inches of soil or topdressing in the proposed plan and 36 inches of soil or topdressing in the comparison case.

- Cover the tailing pond outslopes, including the slurry pipelines, with 24 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Cover the disturbed area associated with the tailing ponds with 18 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Construct spillways and down chutes as necessary to direct excess water off the tailing pond surfaces.
- Apply angular rock and construct vee ditches on the tailing pond outslopes to reduce erosion and control runoff.
- Revegetate the covered areas with native grasses, shrubs, and forbs.

Additional closure/closeout activities planned for the DP-484 area consist of:

- Demolish and bury the tailing termination tower.
- Remove the crane-mounted tailing slurry cyclones and the tailing area maintenance facility.

6.2 Mining Facilities Not Within the Outlined Discharge Plan Areas

A few facilities or areas at the Chino Mine do not lie within the outlined discharge plan areas. The closure/closeout activities for these facilities are discussed in Sections 6.2.1 and 6.2.2.

The mine maintenance facilities area is discussed in detail in Section 2.7.3. Figure 6-15 shows the maintenance and support facilities within this area.

6.2.1 Mine Maintenance Facilities

6.2.1.1 Mining Facilities to be Closed

The mine maintenance facilities area is one of the proposed industrial PMLU areas and covers about 80 acres. Any of the auxiliary structures in the mine maintenance facilities area that are not designated for post-closure use will be removed and salvaged upon closure.

6.2.1.2 Existing Closure Components

Closure activities and related engineering controls implemented to date at the mine maintenance facilities area include diversion of stormwater runoff from paved areas to existing sediment/stormwater control ponds.

6.2.1.3 Planned Closure/Closeout Activities

The planned approaches for closure/closeout activities at the mine maintenance facilities area are:

- Remove all debris and visually affected soil at or near the surface in unpaved areas.
- Dispose of debris or affected soil in an approved manner.
- Collect confirmation samples from areas where soils were removed.
- Reclaim the large truck wash rack area with clean soil.
- Cover unpaved areas with nominally 18 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Revegetate covered areas with native grasses, shrubs, and forbs.

6.2.2 Groundhog Mine Area

The Groundhog Mine area is discussed in detail in Section 2.7.6. Figure 6-16 shows the mining facilities within this area.

6.2.2.1 Mining Facilities To Be Closed

Mining facilities to be closed at the Groundhog Mine area include the Groundhog No. 5 stockpile and associated disturbed areas in Lucky Bill Canyon. This area covers about 2 acres.

6.2.2.2 Existing Closure Components

Closure activities and related engineering controls implemented to date in the Groundhog Mine area include:

- Consolidating, covering, and revegetating several small stockpiles in Bayard Canyon into one stockpile near the saddle at the head of Bayard Canyon
- Constructing a headwall structure to control stormwater runoff/seepage downgradient of the covered stockpile and runoff controls to control erosion at several locations

6.2.2.3 Planned Closure/Closeout Activities

Planned site-specific activities for the Groundhog Mine area are outlined below:

- Remove remaining solid waste debris in the area of the Groundhog No. 5 stockpile.
- Grade the stockpile top surface as necessary to support placement of the cover and provide appropriate drainage.
- Cover the top surfaces of the stockpile and, as feasible, the outslopes with 24 inches of topdressing in the proposed plan and with 36 inches of topdressing in the comparison case.
- Construct spillways and down chutes as necessary to direct excess water off the covered top surface.
- Cover disturbed areas with 18 inches of topdressing in the proposed plan and 36 inches of topdressing in the comparison case.
- Revegetate covered areas with grasses, shrubs, and forbs.
- Plug and abandon the Groundhog Mine shafts.

6.2.3 South Mine Area Topdressing Borrow Pit

6.2.3.1 Mining Facilities To Be Closed

Mining facilities to be closed include:

- A borrow pit for topdressing material located outside current DP areas (Drawing Chino-02, Appendix B).

6.2.3.2 Existing Closure Components

There are not existing closure components in the area of the proposed borrow pit that have not been identified in specific DP areas.

6.2.3.3 Planned Closure/Closeout Activities

Planned site-specific activities for the proposed borrow pit are outlined below:

- Grade sideslopes to a stable configuration.
- Rip the pit bottom and slopes.
- Revegetate with grasses, shrubs, and forbs.
- If practical, incorporate the borrow pit into the post-closure water management system.

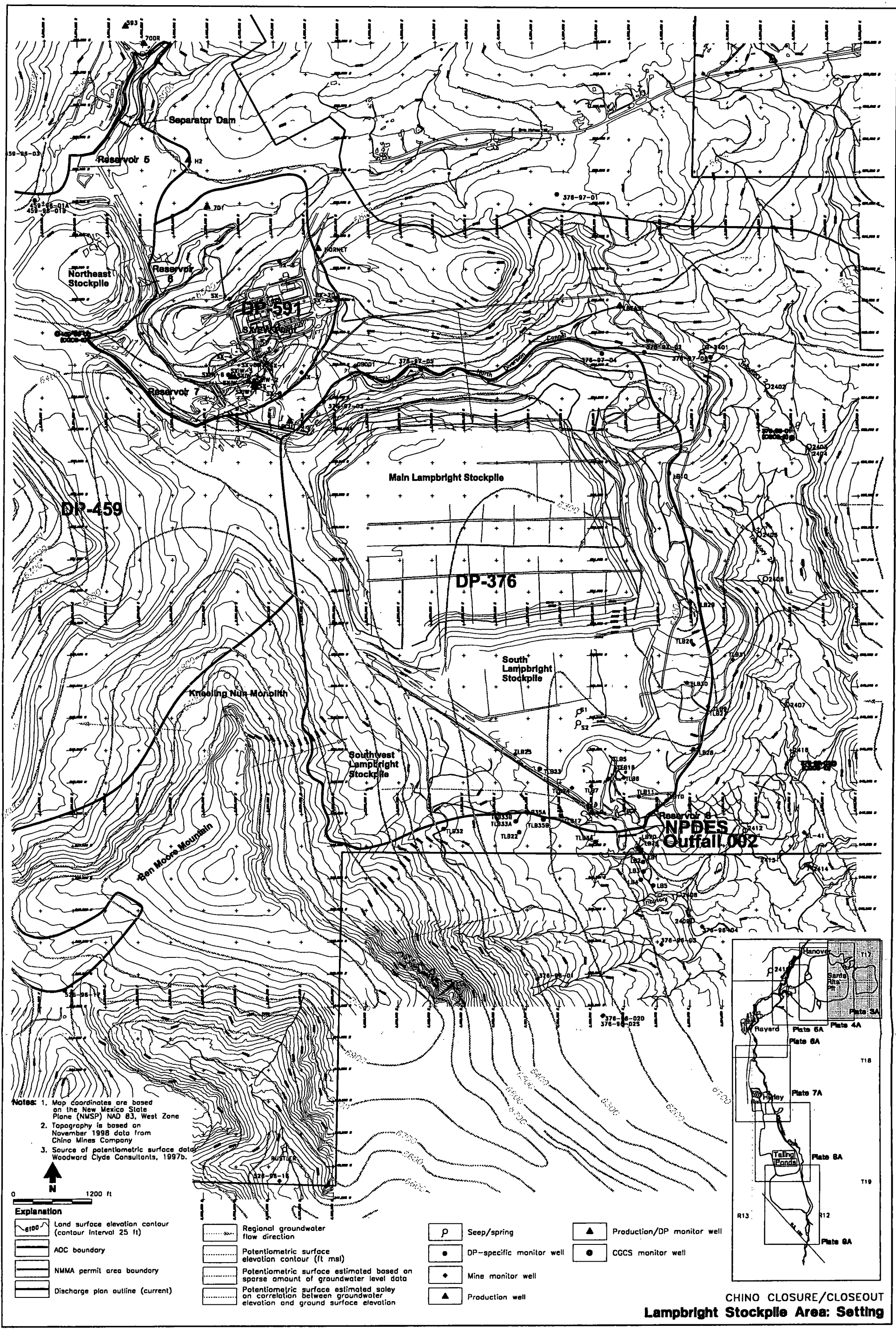


Figure 6-1

CHINO CLOSURE/CLOSEOUT
Lampbright Stockpile Area: Setting

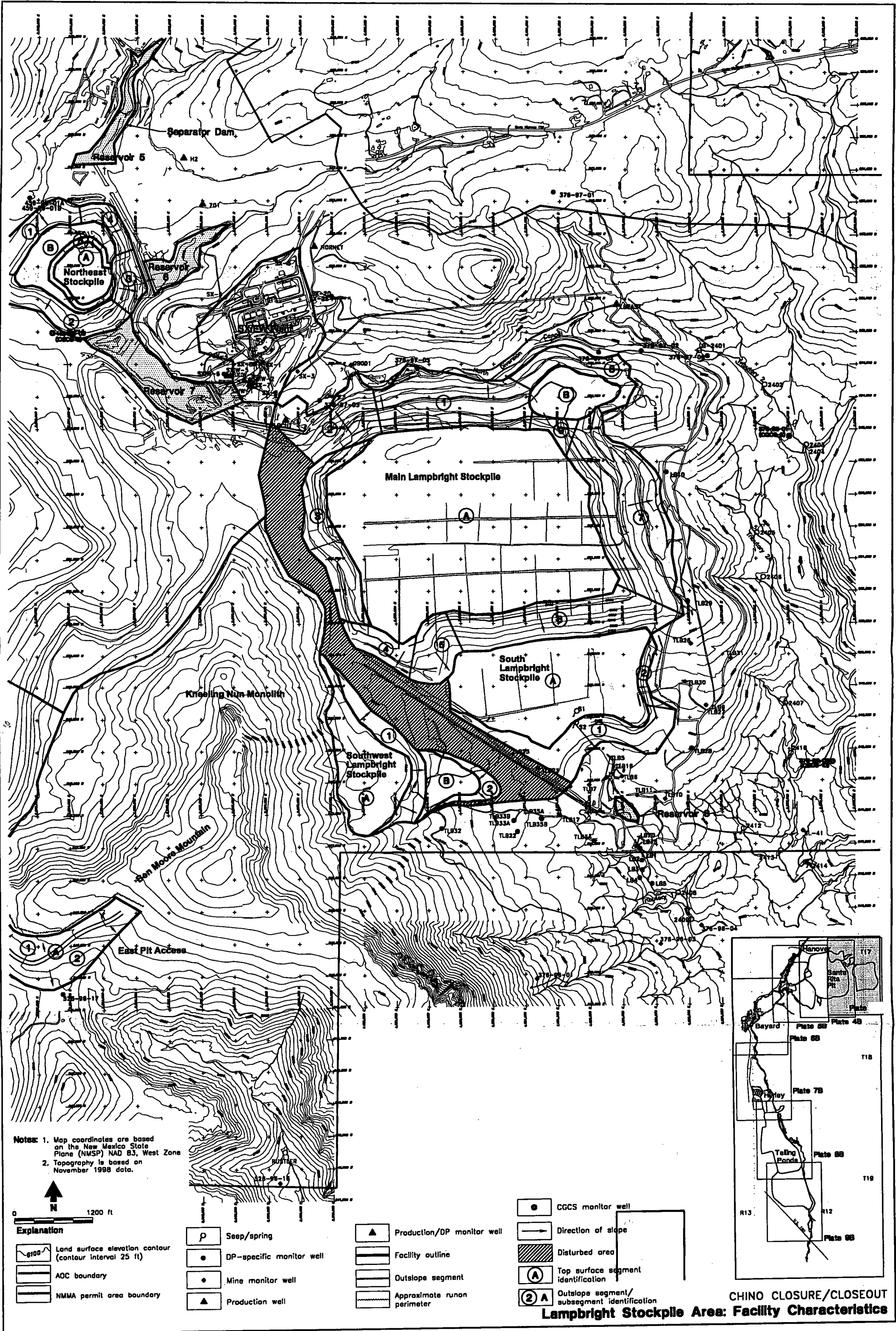


Figure 6-2

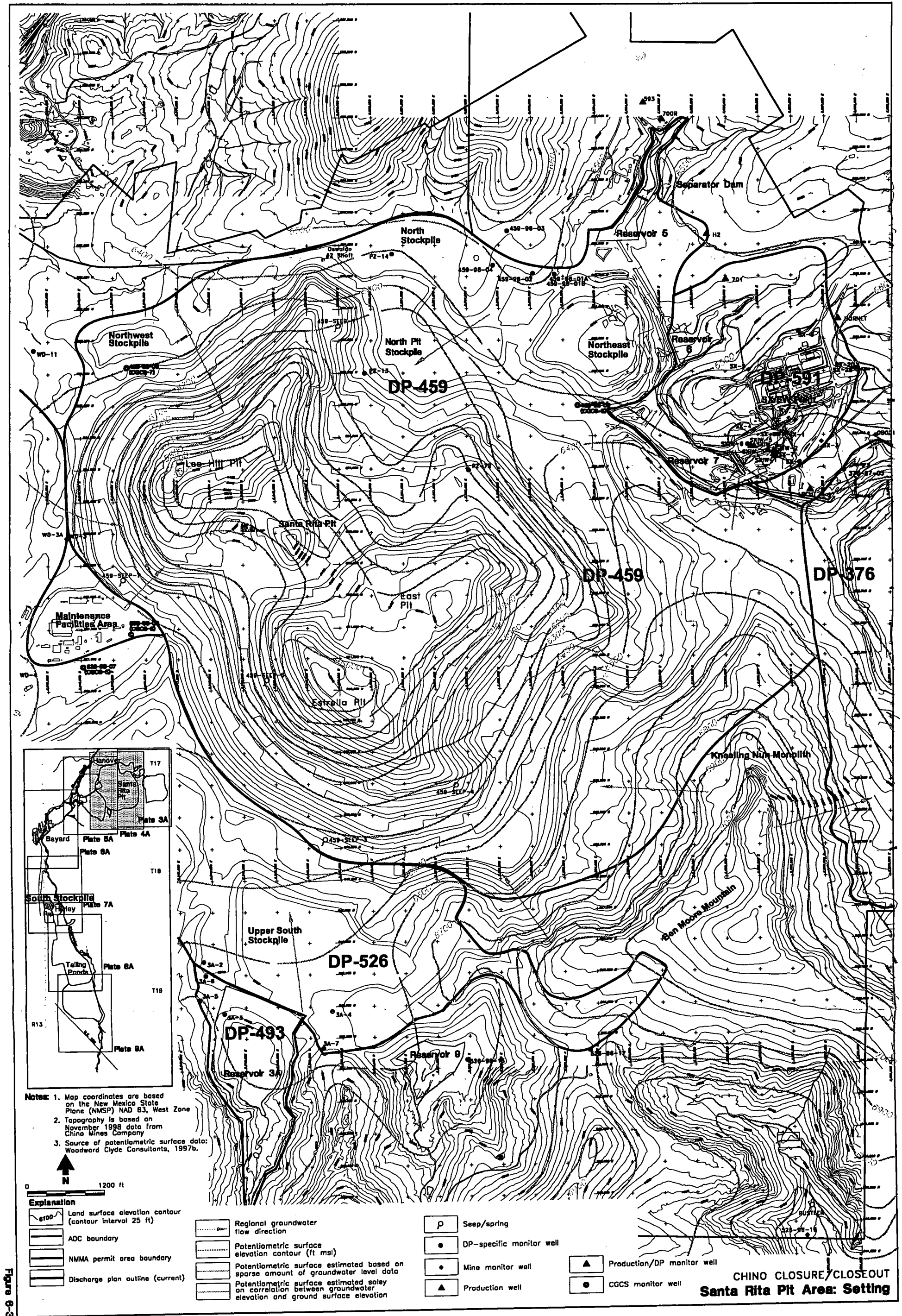
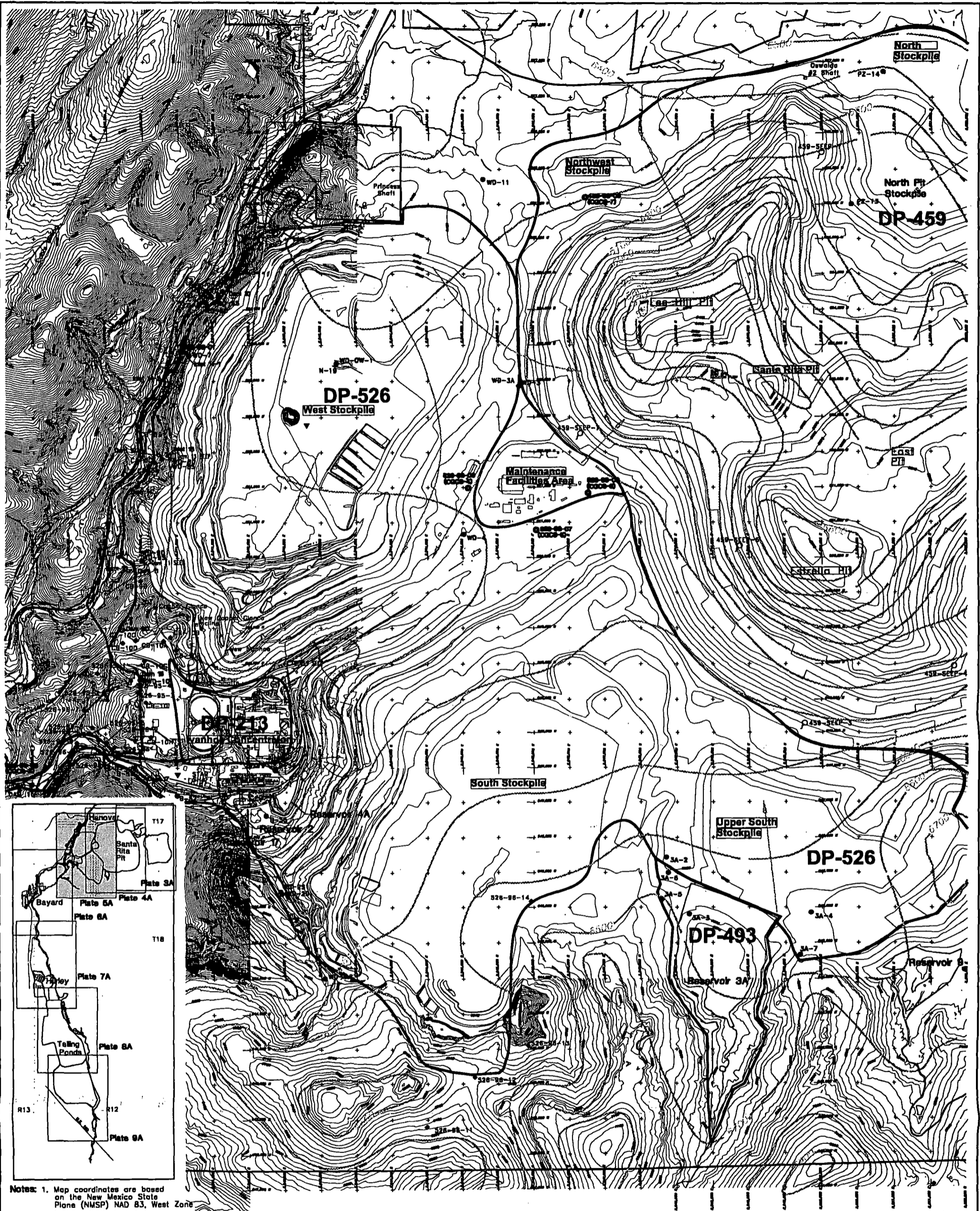


Figure 6-3



Figure 6-4



- Notes:
1. Map coordinates are based on the New Mexico State Plane (NAD 83, West Zone)
 2. Topography is based on November 1998 data from Chino Mines Company
 3. Source of potentiometric surface data: Woodward Clyde Consultants, 1997b.

0 1200 ft

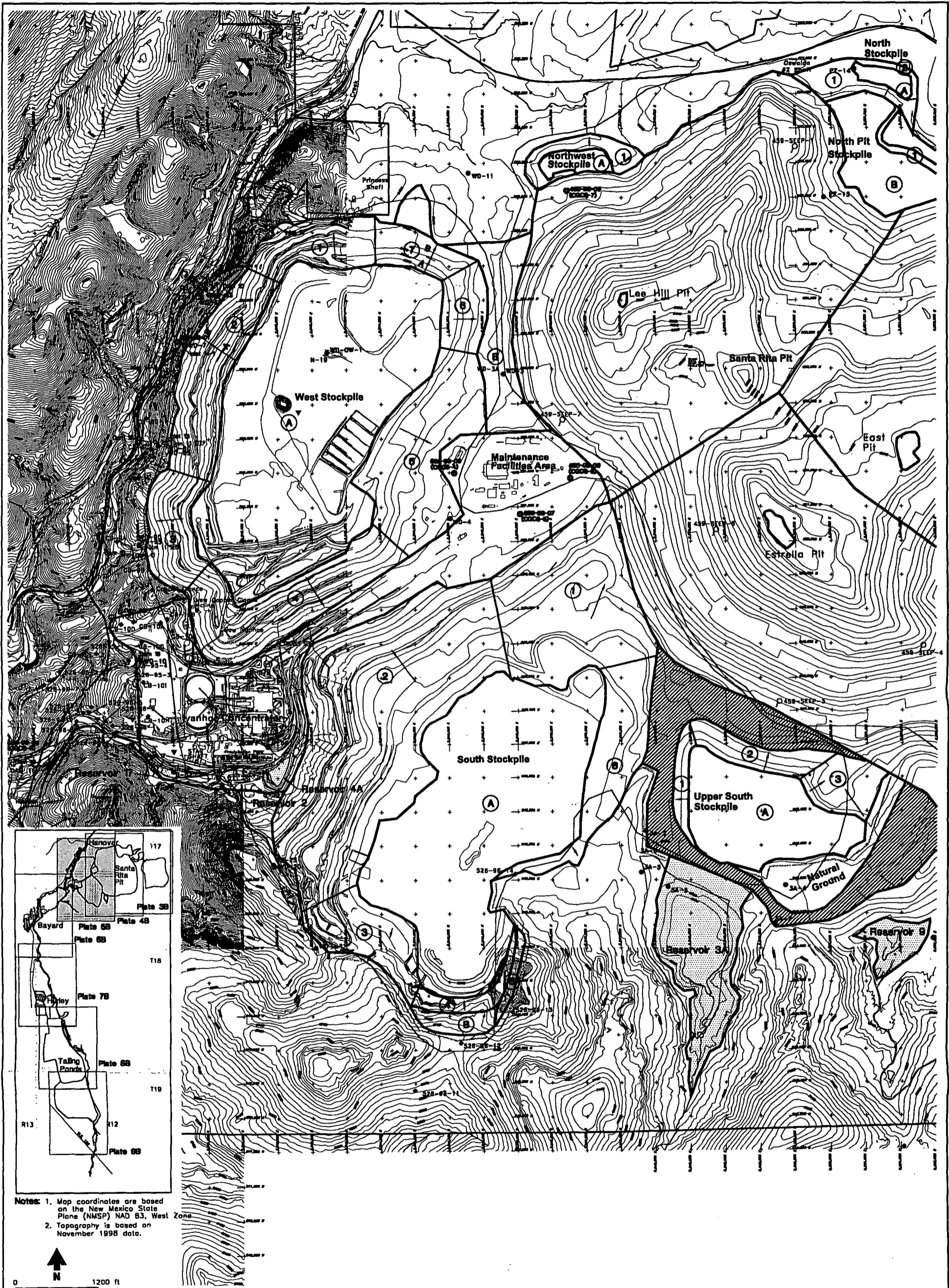
Explanation

- Land surface elevation contour (contour interval 5 ft and 25 ft)
- AOC boundary
- NMMA permit area boundary
- Discharge plan outline (current)
- Pipeline corridor

- Regional groundwater flow direction
- Potentiometric surface elevation contour (ft msl)
- Potentiometric surface estimated based on sparse amount of groundwater level data
- Potentiometric surface estimated solely on correlation between groundwater elevation and ground surface elevation

- Seep/spring
- DP-specific monitor well
- Mine monitor well
- Production well
- CGCS monitor well
- CGCS-sampled stockpile

CHINO CLOSURE/CLOSEOUT
West and South Stockpiles Area: Setting



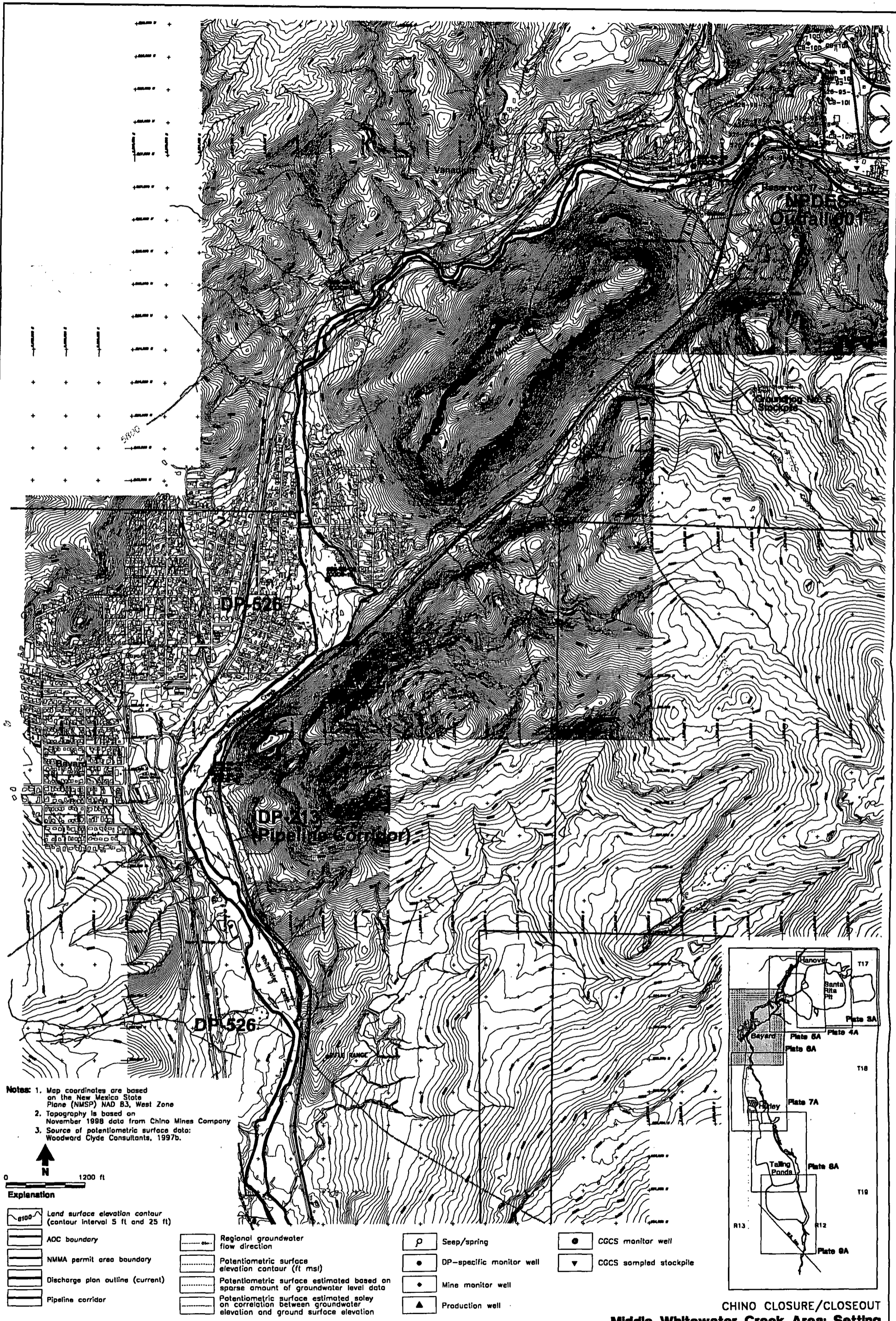
Notes: 1. Map coordinates are based on the New Mexico State Plane (NAD 83, West Zone).
 2. Topography is based on November 1998 data.



Land surface elevation contour (contour interval 5 ft and 25 ft)	Seep/spring	CGCS monitor well	Approximate runoff perimeter	Disturbed area
AOC boundary	DP-specific monitor well	CGCS-sampled stockpile	Top surface segment identification	
NMMA permit boundary	Mine monitor well	Facility outline	Outslope segment/subsegment identification	
	Production well	Outslope segment	Direction of slope	

CHINO CLOSURE/CLOSEOUT
 West and South Stockpiles Area: Facility Characteristics

Figure 6-6

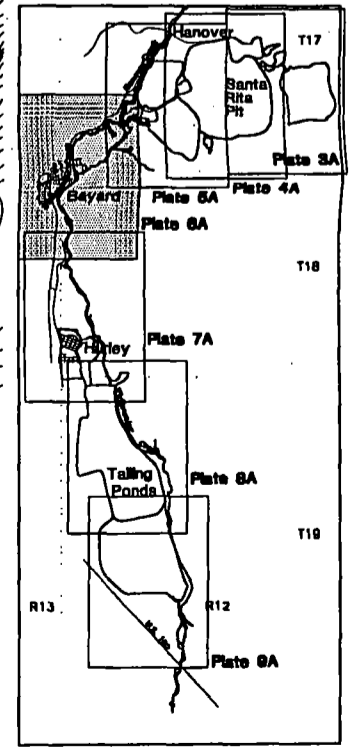


Notes: 1. Map coordinates are based on the New Mexico State Plane (NMSP) NAD 83, West Zone
 2. Topography is based on November 1998 data from Chino Mines Company
 3. Source of potentiometric surface data: Woodward Clyde Consultants, 1997b.

0 1200 ft
 N

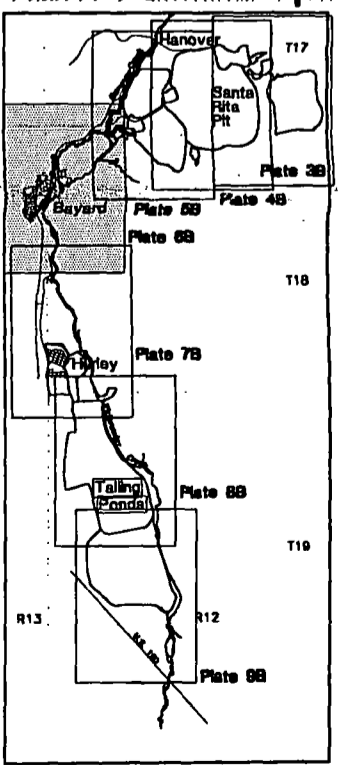
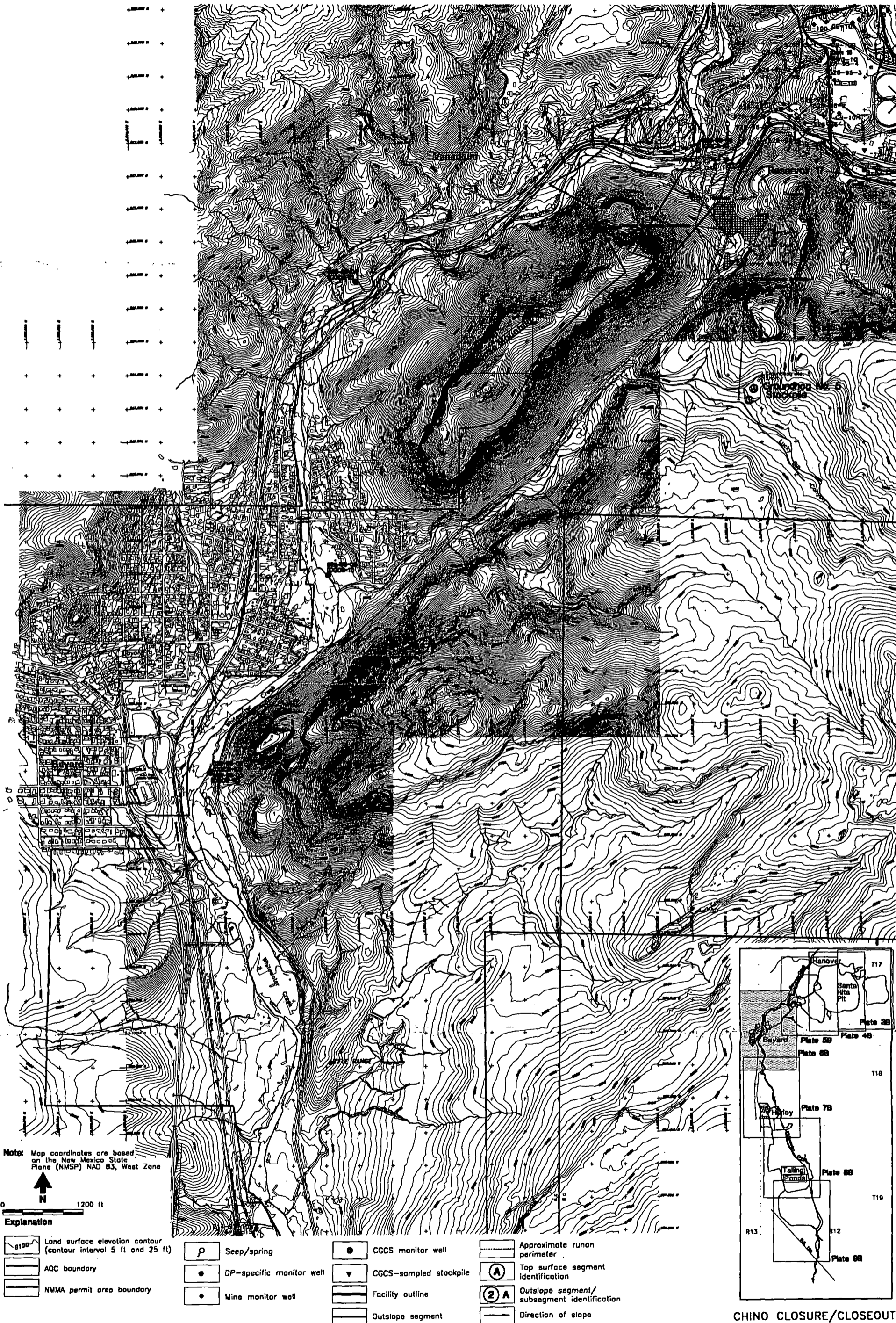
Explanation

- | | | | |
|--|---|--------------------------|------------------------|
| Land surface elevation contour (contour interval 5 ft and 25 ft) | Regional groundwater flow direction | Seep/spring | CGCS monitor well |
| AOC boundary | Potentiometric surface elevation contour (ft msl) | DP-specific monitor well | CGCS sampled stockpile |
| NMMA permit area boundary | Potentiometric surface estimated based on sparse amount of groundwater level data | Mine monitor well | |
| Discharge plan outline (current) | Potentiometric surface estimated solely on correlation between groundwater elevation and ground surface elevation | Production well | |
| Pipeline corridor | | | |



CHINO CLOSURE/CLOSEOUT
 Middle Whitewater Creek Area: Setting

Figure 8-7



CHINO CLOSURE/CLOSEOUT
Middle Whitewater Creek Area: Facility Characteristics

Figure 8-8

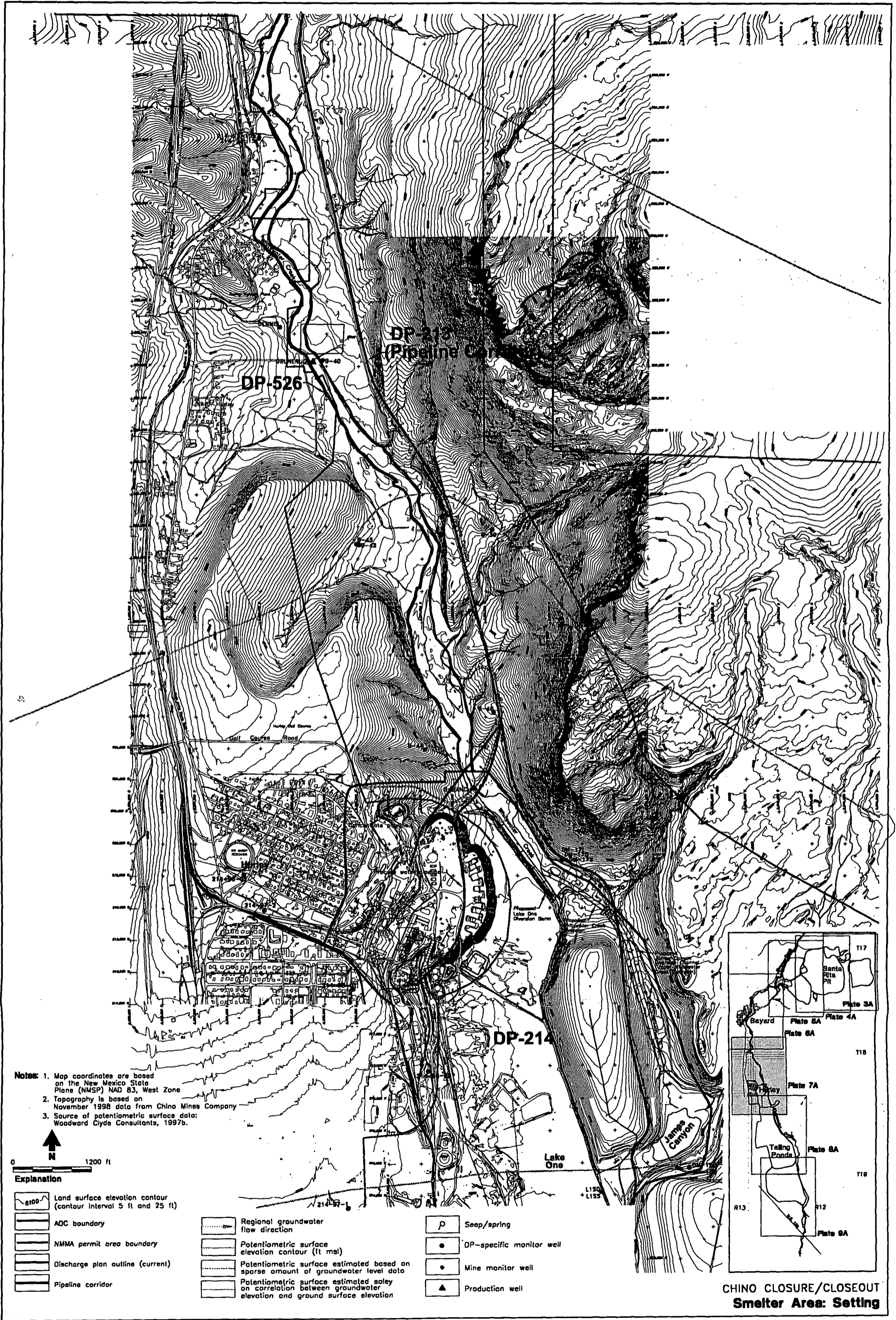


Figure 8-9

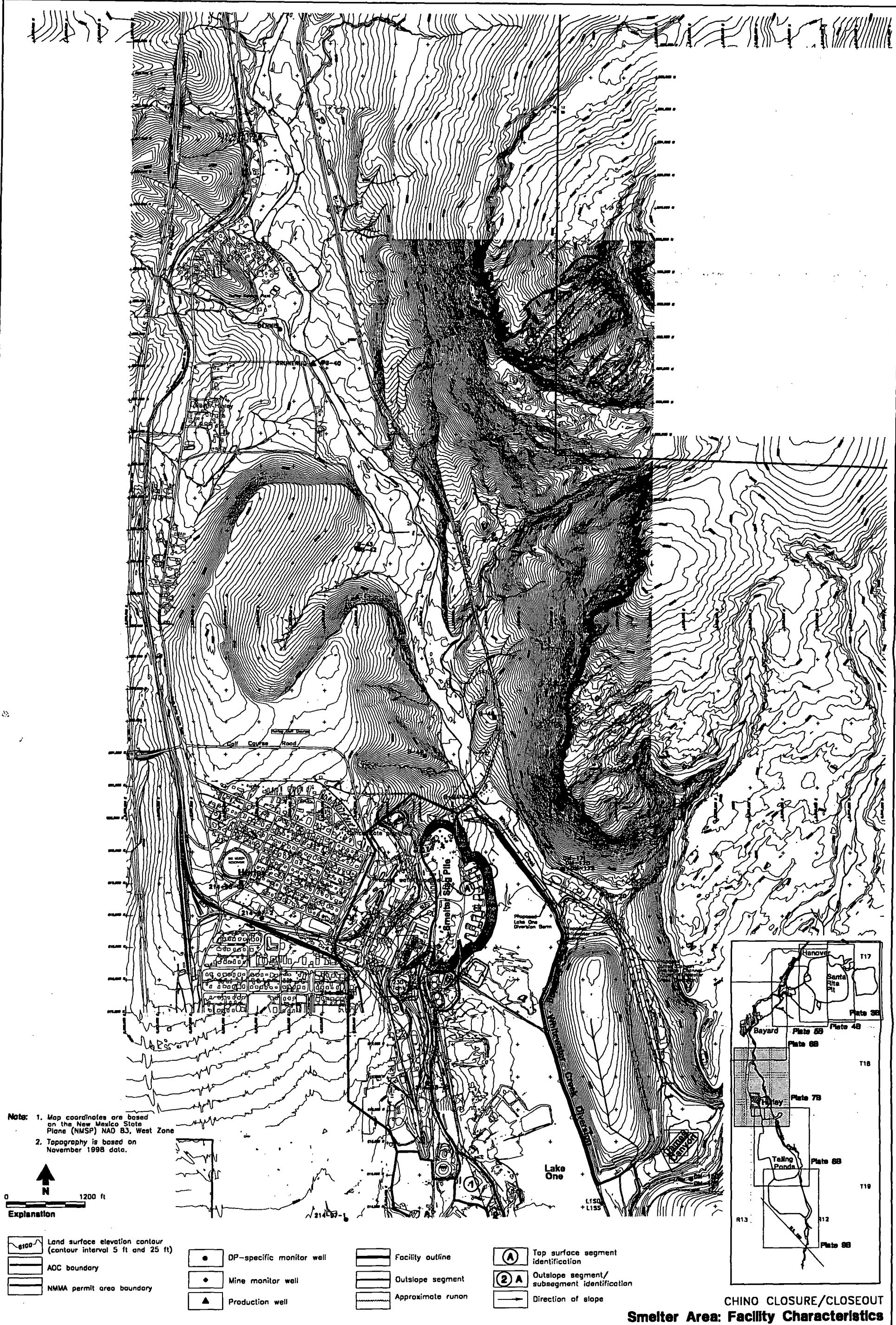


Figure 8-10

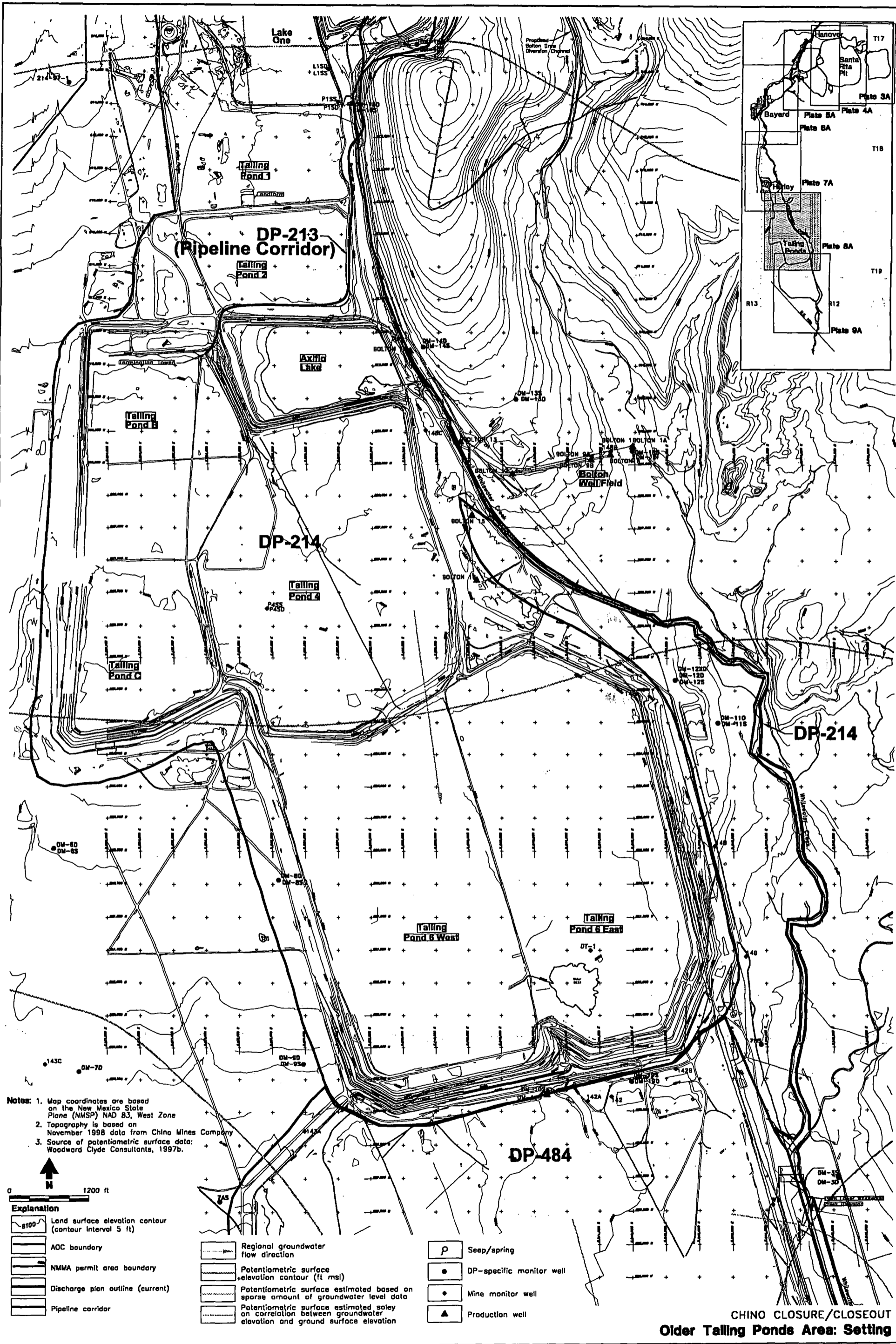
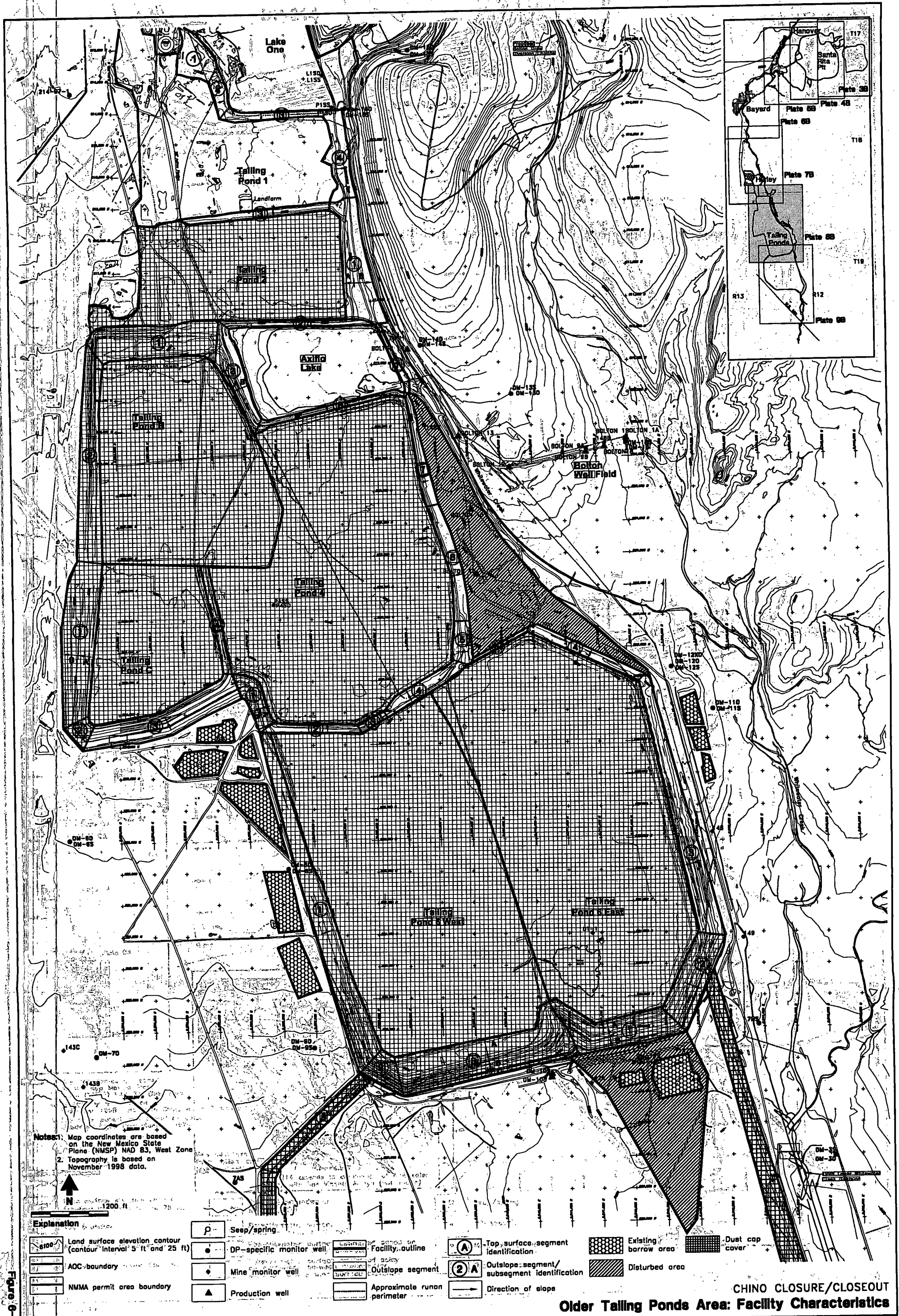
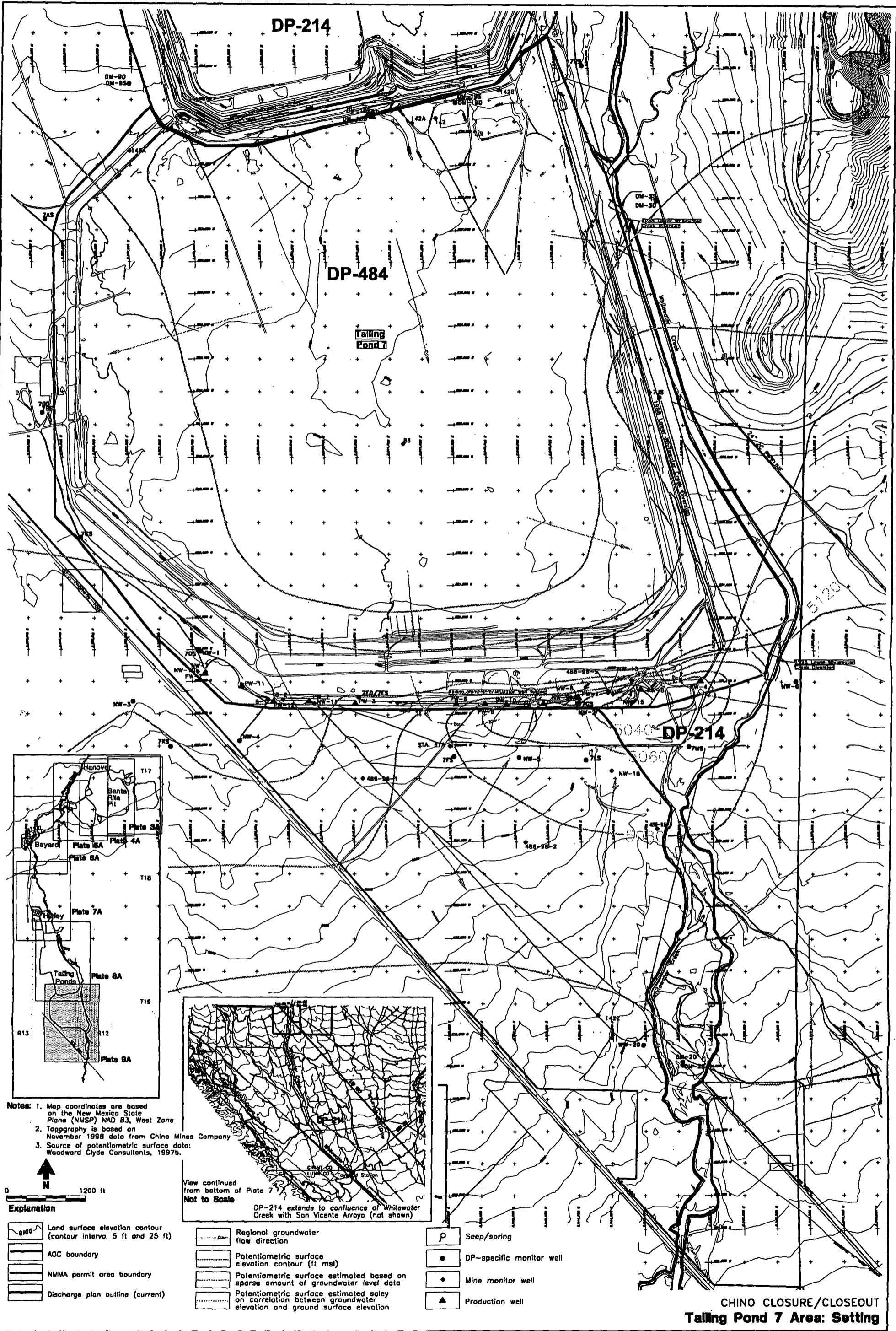


Figure 8-11





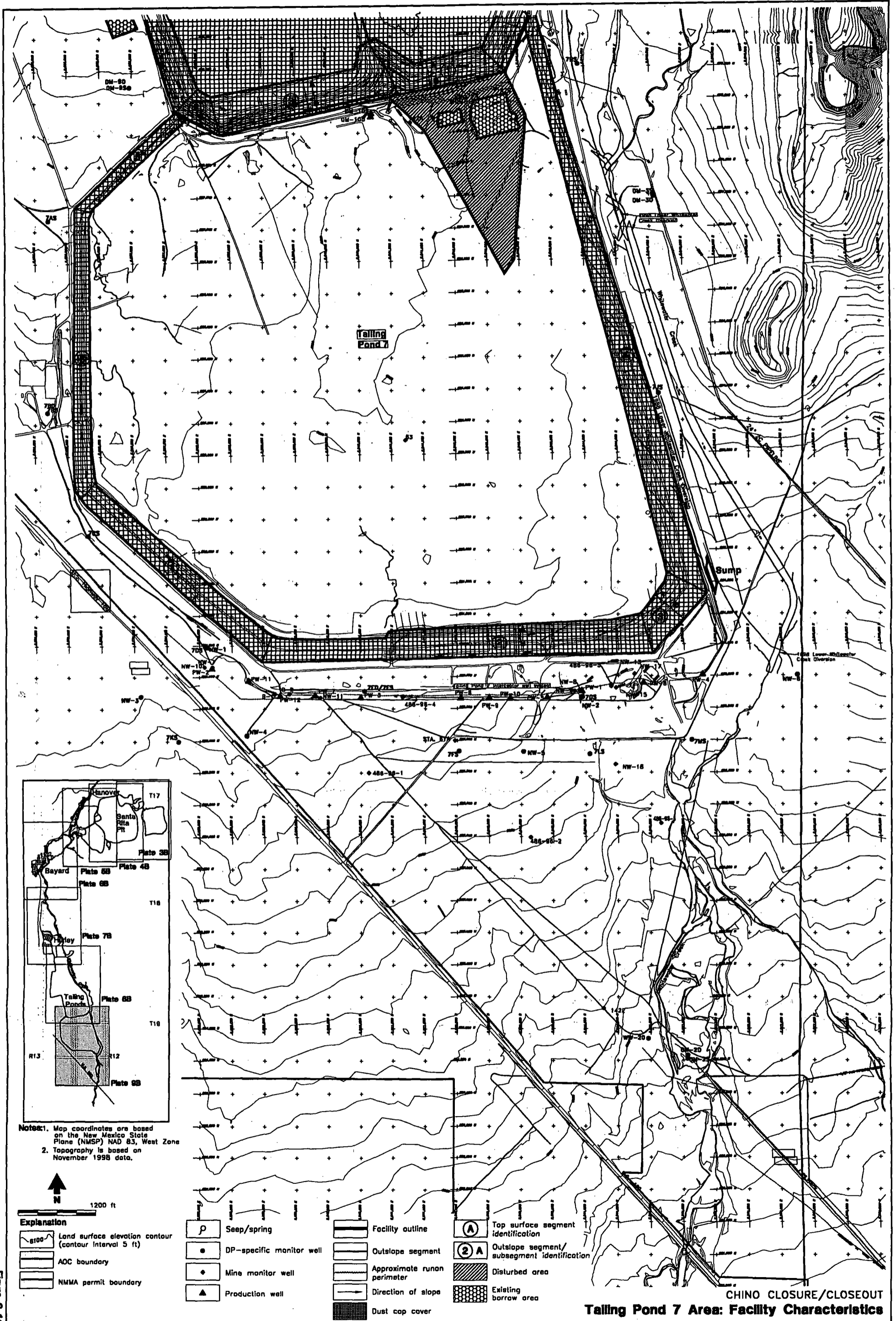


Figure 6-14

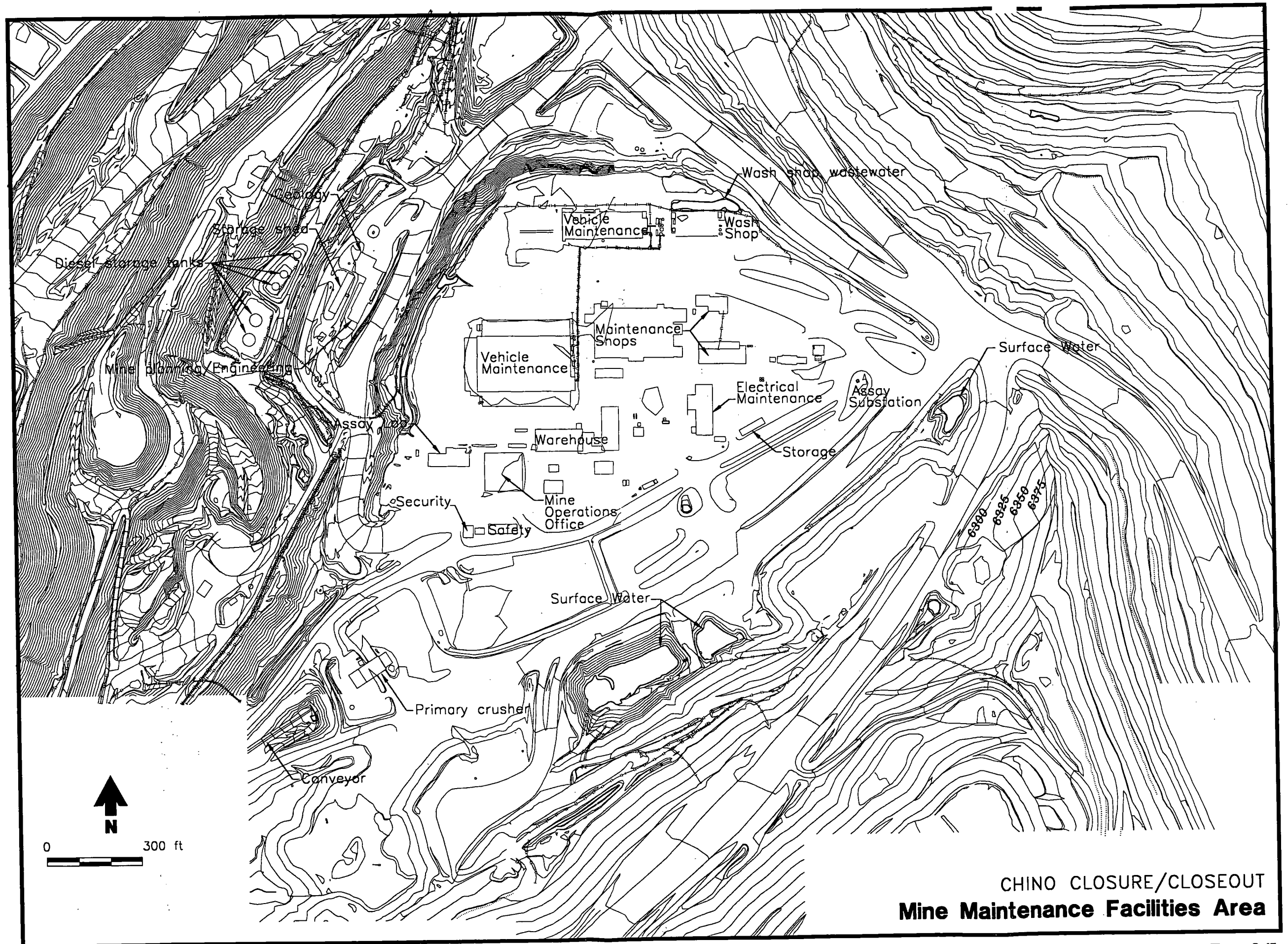


Figure 6-15

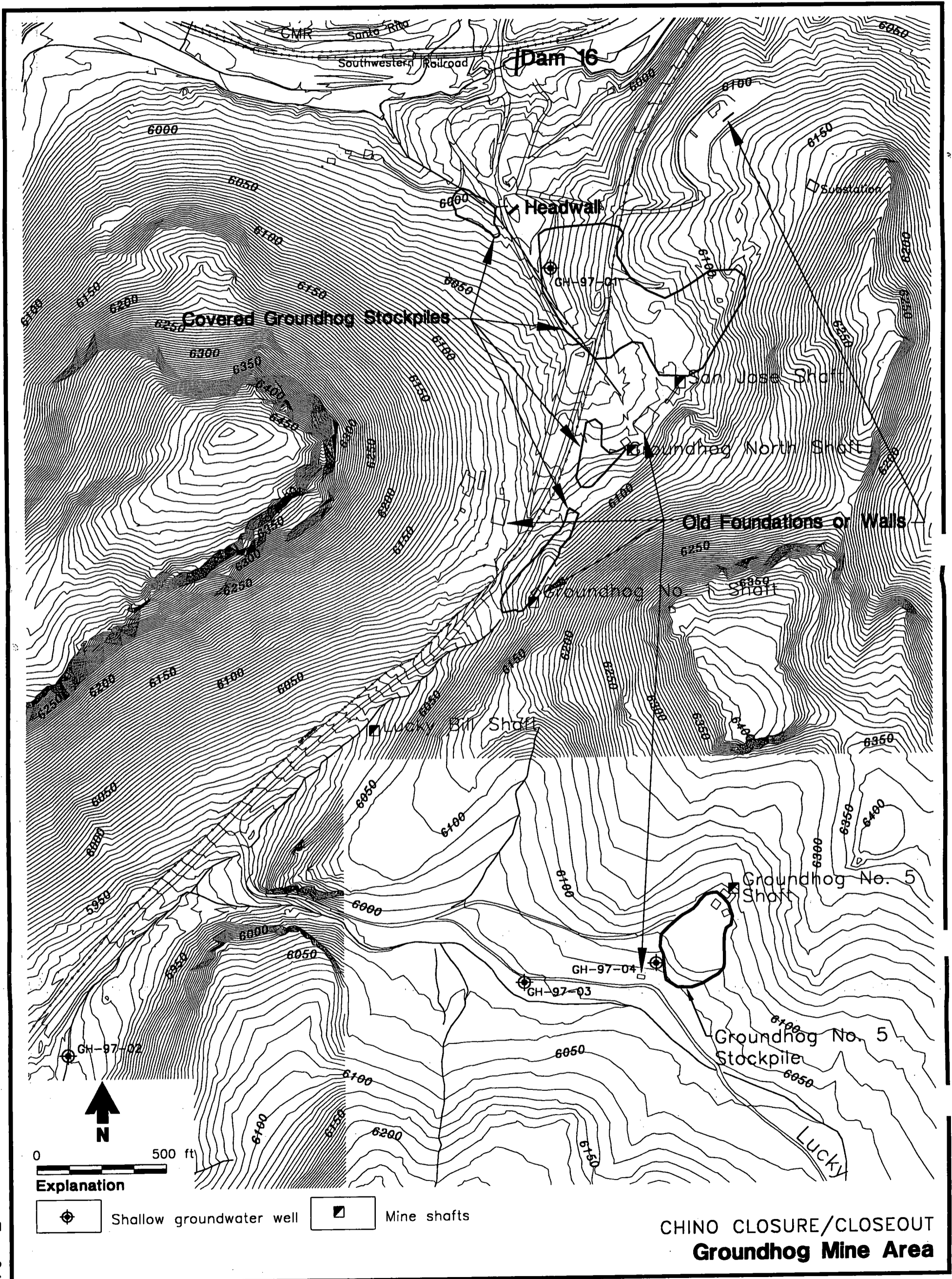


Figure 6-18